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SURGERY AND THE BASIC SCIENCES

THE APPLICATION OF RECENT CONTRIBUTIONS IN BASIC MEDICAL SCIENCES TO SURGICAL PRACTICE

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HYPERTENSION

THERE never has been agreement as to the exact character and distribution of vascular lesions associated with essential hypertension in man. In view of this fact Moritz and Oldt (1) have undertaken an extensive investigation of arteriolar changes in a large number of hypertensive and non-hypertensive patients in an attempt to discover lesions which might be characteristic of the disease, and which, therefore, might reveal information concerning its etiology and pathogenesis. They found three histological types of chronic arteriolar lesions which were present in both the hypertensive and non-hypertensive patients. The first of these lesions was intimal hyalinization, which these authors believe is characteristic of simple arteriosclerosis, and which they found progressed in extent and intensity with advancing age. The second lesion was hypertrophy and degeneration of the media, which resembled the changes which follow distention of any hollow muscular organ. This lesion occurred with somewhat greater frequency and severity in the hypertensive patients. The third type of lesion consisted of endothelial hyperplasia. It was seen in association with inflammation, when it was properly called endarteritis obliterans. It was also seen in vessels in which the capillary beds had been reduced by parenchymatous atrophy and presumably represented involutional changes. It was also observed in cases of hypertension in which it may have represented a primary vascular inflammation or an accelerated process of arteriosclerosis. Although relative thickening of the arteriolar wall, which expressed itself as an increased external diameter with unchanged internal diameter, was characteristic of the hypertensive cases as a group, this change was of no value in the differentiation of a hypertensive from a non-hypertensive individual; nor was it of any value in differentiation of the types of essential hypertension. Although the arteriolar changes were frequent and widely distributed in both groups of patients, one characteristic was discovered which served almost without fail to distinguish a hypertensive from a non-hypertensive individual. Of 200 cases studied, renal arteriosclerosis was present in 109, and in 97 of these chronic hypertension was present. On the basis of these results Moritz and Oldt concluded that renal arteriosclerosis is the most common cause of chronic hypertension. They further concluded that the only site of arteriosclerosis which is significant in the causation of hypertension is the kidney. We shall see that there is ample experimental evidence which supports these conclusions. A survey of the clinical histories of the subjects in regard to the rate of progress of the disease, the average age at death, and the cause of death disclosed two types of hypertension. One group of patients died of renal insufficiency, and the disease was best described as "malignant" hypertension; the other group died of heart failure or cerebral hemorrhage, and the condition was best

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described as "benign." These terms, however, were applicable only in retrospect since the course of the disease could not be predicted from its early manifestations. The factor which determined whether the disease was to run a rapid course with early death from renal failure was not the degree of hypertension, but rather the rate of progressive renal destruction. The difference between the malignant and benign forms is quantitative, not qualitative; the malignant form is more severe and it runs an accelerated course.

As mentioned above Moritz and Oldt concluded that renal arteriosclerosis, presumably resulting in ischemia, is the cause of chronic hypertension. This conclusion is supported by ample experimental evidence that renal ischemia following partial constriction of the renal arteries results in chronic hypertension in dogs (Goldblatt, Lynch, Hanzal, and Summerville, 2). Their conclusion that the kidney is probably the only site where arteriosclerosis will produce this effect is also supported by experimental evidence. Goldblatt, Lynch, Hanzal, and Summerville (2) produced ischemia of the spleen and of the whole lower extremities, without producing a rise in the blood pressure. Rytand (3) produced coarctation of the aorta at various levels and found that hypertension resulted only when the coarctation rendered the kidneys ischemic.

The opinion that malignant hypertension differs from the benign only in its severity and rapidity of development also finds support in recent animal experimentation (Goldblatt, 2). A moderate constriction of the renal arteries in dogs produces a benign form of chronic hypertension which may persist for many years without evidence of renal failure. On the other hand, if the constriction of the renal artery is too severe the animal develops a hypertension accompanied by uremia, and death from renal insufficiency rapidly ensues. This condition more closely resembles the malignant form of hypertension as seen in man but probably represents a condition even more acute. If it were possible to produce a controllable and progressive constriction of the renal arteries in dogs, it would undoubtedly be possible to simulate all the various degrees of malignant and benign hypertension, as well as the conversion of one into the other, that are seen in man. Apparently when the disease develops very rapidly the kidneys are the first to fail; when the disease develops very slowly the chances that it may be terminated by heart failure or cerebral accidents are greatly increased.

There have been several recent reports on the pathology accompanying experimental hypertension in the dog. Childs (4) finds in the chronic form that the arterioles show definite medial hypertrophy with narrowing of the lumen, a change most pronounced in the gastro-intestinal tract and in the heart. Hyalinization and other changes were also observed in the kidney glomeruli. In the acute form, of which the animals died in uremia within four days, petechial hemorrhages were noted particularly in the gastro-intestinal tract and heart. These extravasations were mainly from the capillaries, for the arterioles were intact. Goldblatt (5) has reported on the pathological changes to be found in the acute form, although somewhat less acute than that just described. He also observed petechial hemorrhages, but they were accompanied by degenerative changes in the arterioles consisting of hyalinization and necrosis. In the chronic form extensive hyalinization was found but no necrosis nor hemorrhages. These findings are similar to those in the clinical disease and suggest a quantitative rather than a qualitative difference in the acute and chronic forms.

In regard to the mechanism of hypertension resulting from renal ischemia, it has been well established that nervous factors are not involved either as afferent or efferent portions of a reflex arc. Section of the splanchnic nerves (Goldblatt, Gross, and Hanzal, 6), posterior spinal nerve roots (Goldblatt and Wartman, 7), total sympathectomy (Heymans, Bouckaert, Elaut, Bayless, and Samaan, 8; Alpert, Alving, and Grimson, 9), renal denervation (Goldblatt, 10; Page, 11; Collins, 12), and cord transection (Glenn, Child, and Page, 13) have all been shown to be without effect on the development of hypertension. The significant point in these experiments is that complete loss of sympathetic vasomotor tone is unable to prevent the hypertension. Goldblatt (10) suggests that the occasional beneficial effects noted clinically from various surgical procedures which involve section of the vasoconstrictor nerves to the kidney are probably due to production of renal vasodilatation with consequent alleviation of the renal ischemia. If this is true, the frequency and degree of success should be the same following denervation of the kidney alone. Of course, such a procedure could not be effective if the arteriosclerosis has advanced to the point where the vessels are no longer capable of dilating. That retention by the kidney is not a factor is shown by the fact that hypertension is not produced by nephrectomy or complete ligation of all the renal arteries (Goldblatt, 10), nor by diverting the ureters into the blood stream (Geer and Dragstedt, 14). There is now some evidence that the mechanism is a humoral one, that the kidney

elaborates a substance which is taken up by the blood stream to produce the rise in the blood pressure. Goldblatt (10) has shown that hypertension will follow constriction of the renal arteries only if venous channels are left open in order to permit access of the active principle into the circulation. Furthermore, Dicker (15) and Houssay and Fasciola (16) have reported that ischemic kidneys from a hypertensive dog when transplanted into a normal dog produce a hypertension in the recipient. Concerning the nature of the substance liberated by the kidney there is little information. It has been shown that guanidine is not the active principle (Goldblatt, Lynch, Hanzal, and Summerville, 2; Helmer and Page, 17).

KIDNEY

Several recent papers have appeared which deal with the subject of the experimental production of acute and chronic glomerulonephritis. Smadel and Farr (18) and Smadel (19) have described the diffuse glomerulonephritis which was produced in rats by the injection of anti-kidney serum (nephrotoxin) prepared by immunizing rabbits to an emulsion of rat kidneys. The injection of large quantities of the nephrotoxin produced an acute glomerulonephritis characterized by swelling of the intercapillary substance of the glomerular tuft and by tubular degeneration. Fibrin deposition was not a constant finding. These changes were accompanied by albuminemia, cylindruria, and anasarca, but not by hematuria. The blood urea mounted rapidly, the urea clearance fell, and death followed in two weeks. The administration of moderate doses of nephrotoxin produced a chronic form of nephritis. The acute lesions merged into scarring of the glomeruli and tubules, and represented a chronic progressive glomerulonephritis with generalized vascular lesions. There was no immediate alteration of the urea clearance, but lipemia and hypoproteinemia appeared accompanied by anasarca. The investigators report that the majority of the animals which survived the initial stage of the disease showed progressive changes, with albuminuria and casts until the time of death. Terminally uremia, hypoproteinemia, and hypertension were observed.

Ehrlich, Wolf, and Bartol (20) have studied acute nephrotoxic glomerulonephritis in rabbits. They found the disease to be characterized by a latent period, during which a hyperemia of the glomeruli was present, accompanied by diuresis. They believe that these findings deny Volhard's theory that vascular spasm initiates glomerulonephritis. This latent period is followed by proliferation of glomerular cells, the typical lesion. Fibrin deposition and crescent formation are not constant and these authors express the opinion that they indicate a complication which aggravates the disease, and are not indicative of the subacute stage. When the glomerular lesions are at their peak, oliguria and albuminuria are present. Results obtained with dye excretion tests reveal impaired glomerular function, without disturbance of tubular function. When the disease progresses to the point where obvious tubular degeneration is present, then dye elimination tests reveal impaired tubular function also. In mild cases of clinical nephritis Goodner and Smith (21) have reported that the glomerular and tubular injury progress parallel, whereas in advanced cases the tubules suffer the more serious damage.

Medlar and Blatherwick (22) have studied a form of chronic glomerulonephritis which is produced experimentally in rats by a special high protein diet. They observed focal injuries in the glomerular filter bed, which gradually spread to include the capsule and finally the tubules. These changes progressed to a chronic degenerative nephritis with glomerular sclerosis and generalized fibrosis. They did not observe the early acute lesions which, as mentioned above, were found by Smadel in the nephrotoxic nephritis. However, the chronic stages of the two types of experimental nephritis were identical. For this reason Medlar and Blatherwick conclude that chronic degenerative nephritis may depend primarily upon irreparable damage to the filter bed of the kidney, and that although the etiological factors may be of many kinds, the end-result in the chronic stage is always the same.

HEART

The earlier belief that specialized conducting tissue is not present in the myocardium led to the generally accepted theory advanced by Lewis that the cardiac impulse is transmitted from the subendocardial Purkinje network to the ventricular muscle by radial muscle conduction. Robb and Robb (23) later suggested that the impulse emerges from the Purkinje network at the apex

and passes toward the base of the heart in paths parallel to the muscle fibers. Recently Abramson and Margolin (24) demonstrated the presence of a Purkinje network continuous with the subendocardial system, which extends throughout the myocardium and interventricular system. In experiments on the heart of the dog, Abramson and Jochim (25) found that the cardiac impulse was not necessarily conducted parallel to muscle fibers, but could be transmitted in any direction, as demanded by the presence of the myocardial Purkinje network. According to their view the impulse spreads from the subendocardial network into the myocardial network and activates practically the whole ventricle simultaneously. Myocardial conduction is not a delayed conduction through muscular tissue as formerly believed, but a rapid conduction through neuromuscular tissue.

There are many contradictory reports in the literature concerning the effect of drugs and physiological states on the flow of blood through the coronary system. Recent studies on the coronary flow in dogs reveal that the methods employed to measure coronary flow have not been reliable, and therefore are probably responsible for inconsistent and contradictory results. As pointed out by Katz, Jochim, and Bohning (26) the rate of blood flow through the coronaries is determined directly by three variables: (a) the pressure gradient between the inlets and outlets of the coronary system; (b) the vasomotor tone of the coronary vessels; and (c) the passive changes in the caliber of the coronary vessels produced by changes in the degree of contraction of the surrounding cardiac musculature. These investigators have recently studied the effects of the last mentioned variable on the coronary flow in the isolated, perfused heart of the dog, under conditions in which the various factors could be rigidly controlled. They report that with all other factors constant, the coronary inflow is inversely related to the intramuscular pressure, which itself is a direct function of the intraventricular pressure. On the other hand, the coronary outflow increases with increase in the intramuscular pressure. From these observations they are forced to the conclusion that under certain conditions, the blood supply to the heart may vary inversely with the work it is doing. They consider the possibility that this vicious mechanism may operate in the normal animal upon excessive exertion, or in acutely developing hypertension, and perhaps also on moderate exertion when the coronaries are diseased. They found also that under certain conditions in the isolated heart, the outflow from the coronary vessels may exceed the inflow through the coronary arteries, as a result of participation of the thebesian channels. They state that the pressure gradients which regulate the rate and direction of flow in the thebesian passages operate during the cardiac cycle in such a way as to produce a significant ebb and flow through these channels.

Katz, Jochim, and Weinstein (27) have studied in greater detail the extent to which the various branches of the coronary system participate in carrying the total blood flow to the heart. They found that the contribution to the total flow made by the various branches varies widely in regard to both inflow and outflow. These wide variations they believe vitiate the conclusions obtained from experiments in which the measured outflow from the coronary sinus has been used as a quantitative index to the effect of various drugs and procedures on the total coronary flow. Previous workers had believed that 60 per cent of the total outflow constantly passes through the coronary sinus. The results of Katz, Jochim, and Weinstein indicate that this value is not only extremely variable, but is probably too high. That portion of the outflow not carried by the coronary sinus empties by way of the thebesian channels mainly into the right heart. They suggest that this may account for the lower incidence of infarction in the right ventricle as disclosed by autopsy material. It was found that constriction of the coronary sinus decreased the coronary inflow, and led to failure of the isolated heart.

Essex, Herrick, Baldes, and Mann (28) have studied the effect of digitalis on coronary inflow, employing a special technique which permitted observations over a long period of time in unanesthetized dogs maintained in perfect physical condition. Digiglusin was administered intramuscularly over a period of days in quantities more than sufficient to digitalize the animals, without the production of any significant change in the blood flow through the circumflex branch of the left coronary artery.

Katz and Mendlowitz (29) have analyzed the metabolic and mechanical changes which accompany spontaneous heart failure in the isolated, perfused heart of the dog. They state that failure of a ventricle is characterized by the ventricle's doing less work at a given diastolic volume, or by its doing the same amount of work at a greater diastolic volume. This decrease in the ratio of diastolic volume to work is apparently a mechanical expression of the decreased contractile power of the ventricle. Dilatation is, therefore, an effect of the failure as well as a method of compensation

which enables the ventricle to continue to perform its work quota. When this compensatory increase in the diastolic volume fails to keep pace with the decrease in the contractile power, the ventricle becomes unable to perform its work and progressive irreversible heart failure ensues. This decline in work done is due not only to a sharp fall in the total energy released, but also to a terminal decrease in the efficiency of energy utilization, or conversion into work. It had previously been believed that a diminished efficiency of the heart played a prominent part in the development of heart failure, but Katz and Mendlowitz maintain that it is only a terminal phenomenon.

The question has never been completely settled as to whether cardiac hypertrophy will result from increased work alone, or whether injury to the heart is an essential contributing factor. That a certain degree of extra work performed by the heart does not necessarily lead to cardiac hypertrophy is indicated by the recent work of Van Liere and Sleeth (30). These investigators determined the ratio of heart weight to body weight in a series of pregnant guinea pigs, cats, and dogs, and were unable to find any demonstrable hypertrophy.

Histological changes in the myocardium in cardiac failure and hypertrophy are rather meager. Recently, Shipley, Shipley, and Wearn (31) in rabbits, and Roberts, Wearn, and Bodal (32) in human material have demonstrated that in the hypertrophied heart the muscle fibers are greatly enlarged, but that the ratio of the number of capillaries to the number of fibers remains unchanged, a fact which shows that the capillaries do not multiply to keep pace with the enlarged muscle mass. They were able to show that the increase in the volume of muscle tissue which must be supplied by each capillary is approximately proportional to the degree of cardiac hypertrophy. The relationship of this presumably diminished blood supply to the development of heart failure is obvious.

Because of the meager histological changes which accompany heart failure, Herrmann and Decherd (33) and Decherd and Blum (34) have investigated the chemical changes which occur under these conditions. Since it is well known that the potassium salt of creatin phosphoric acid is involved in the chemical transformations which liberate the energy necessary for muscular contraction, these workers have first directed their attention to the study of these compounds. They have found that the hypertrophied heart, whether from clinical or experimental material, shows an increase in creatine content, suggestive of increased activity. In hearts which have failed, however, they have observed a marked fall in potassium, creatine, and non-lipoid phosphates. Continuation of such experiments may contribute important information for an understanding of the process of heart failure.

CIRCULATION

Friedlander, Silbert, Bierman, and Laskey (35) have offered an explanation for the failure of ganglionectomy and paravertebral injections of alcohol to relieve intermittent claudication. In human subjects thermocouples were employed to record superficial temperatures and temperatures deep within the muscles. Temperature changes served as an index to the blood flow in these areas. It was found that spinal anesthesia and anesthesia of the spinal roots, which eliminated sympathetic influences from the limb, resulted in an increase in the superficial circulation, but had no effect on the blood flow through the muscles. The intravenous administration of hypertonic salt solution produced a definite increase in the blood flow through both the superficial and muscular tissue. This provides experimental evidence supporting the use of hypertonic salt solutions in the treatment of intermittent claudication.

Alam and Smirk (36) have demonstrated in man that exercise of a limb or a portion of a limb while circulation is restricted by means of a sphygmometer cuff elicits a reflex rise in the blood pressure and pulse rate. The reflex is elicited by the action of retained metabolites upon the sensory endings in the muscle itself. This is presumably a mechanism for assuring an adequate supply of blood to the exercising muscles. Pain of the intermittent claudication type is also produced under these circumstances. Recently Maison and Forster (37) have shown that a change in pH is not the factor which stimulates the pain receptors in ischemic muscles during exercise.

It is now widely accepted that one of the primary factors in traumatic shock is the oligemia which results from loss of blood and plasma into the injured area, and perhaps into the tissues in general, if the blood pressure remains below a critical level for a considerable length of time. For this reason methods of restoring the blood volume assume immense practical importance. It has been repeatedly demonstrated that the

administration of saline solution in shock maintains the blood pressure only temporarily, and frequently only during the period of injection. That such treatment may be injurious as well as ineffective has also been shown. Davis (38) has reported that the conditions of anoxemia and reduced oxygen consumption in experimental shock are aggravated by the administration of saline solution because this procedure augments the loss of blood protein and cells into the traumatized area, and to some extent into the tissues in general. Hepler and Simonds (39) have shown in experimental shock in the dog that large quantities of injected salt solution are very rapidly lost from the circulation, which causes edema in the gastro-intestinal tract and probably in the liver as well. They found the lumen of the stomach to contain as much as 200 c. cm. of clear fluid after injections of saline solution. If there is a traumatized area, or if the blood pressure has remained low for a period sufficient to increase the capillary permeability, it is only to be expected that even a temporary increase of the blood pressure by means of saline injections will hasten the loss of necessary blood cells and blood protein from the circulating fluid. Furthermore, simple reduction of the colloid osmotic pressure of the blood by continuous dilution with saline solution will tend to promote edema, a complication which can only aggravate the situation. In a normal or dehydrated individual excessive amounts of fluid can be easily tolerated, but this has not been found to be true in the individual who is suffering from shock.

Solutions of gum acacia in saline solution have been widely used as a substitute for pure saline solution for the restoration of the blood volume. Its colloid osmotic pressure retains it within the vascular system so that it is apparently as effective as serum for the maintenance of the blood pressure after hemorrhage in dogs (Robertson, 40). However, Heckel, Erickson, Yuile, and Knutti (41) have reported that injections of acacia reduce the plasma proteins in normal dogs. Low levels of plasma protein accompanied by marked histological changes in the liver may be maintained for weeks by repeated injections. These workers consider that this effect may be due either to liver injury with inability on the part of the patient to form blood protein, or to a compensatory decrease in the protein formation, the purpose of which is the maintenance of a normal blood osmotic pressure. That hepatic injury may be at least partially responsible is suggested by the work of Hall (42). This investigator found that the injection of acacia into dogs reduces the plasma protein including fibrinogen, and that this is accompanied by impaired liver function as revealed by galactose and glucose tolerance tests. The clinical use of acacia is therefore not without its dangers. No satisfactory substitute for fresh blood exists when a transfusion is indicated.

Obviously the ideal treatment for blood loss or oligemia is a blood transfusion. However, the expense and inconvenience of the usual blood transfusion has stimulated attempts at the storage of blood obtained from normal individuals, placentas, and even cadavers. Davis and White (43) have recently suggested that peritoneal transudates might provide an easily available and inexpensive substitute for blood. They found that ascitic fluid contained from 2 to 3 per cent protein with an albumin-globulin ratio of 1.1 to 2.3, and should therefore be able to contribute significantly to the colloid osmotic pressure of the blood of a transfused subject. In anesthetized dogs after hemorrhage, they found that ascitic fluid was effective in the restoration of blood pressure and that the effect persisted long after the cessation of the injection. The animals survived the hemorrhage, the transfusion, and the anesthesia without immediate or delayed deleterious effects. Ascitic fluid to be used for this purpose is subjected to a Kahn test and its sterility is tested by blood agar cultures. Because antibodies are present in the fluid, it must be tested for compatibility with the recipient's blood. The advantages of ascitic fluid are that it can be stored for long periods in the cold without preservatives and yet remain sterile; it contains human proteins; it is available in any large hospital and costs nothing; however, no satisfactory substitute for fresh blood exists when a transfusion is indicated.

CEREBELLUM

The functions of the cerebellum have never been clearly understood. There has never been complete agreement in regard to the effects produced by removal of this portion of the brain; localization of function has been reported to be non-existent on the one hand and as definite as in the cerebral motor cortex on the other. Within recent years, however, important advances have been made which promise to clarify to a great extent the function of the cerebellum. The newer knowledge has been excellently reviewed by Fulton and Dow (44) and it is from their review

that much of the present discussion has been taken.

Recent investigations concerning the comparative anatomy of the cerebellum have contributed valuable information and a new systematic terminology to replace the previous difficult terminology (Larsell, 45). This terminology divides the cerebellum essentially into three main divisions which are phylogenetically, anatomically, and functionally distinguishable. The most primitive of the three divisions is the flocculonodular lobe whose connections are solely vestibular. It is functionally concerned with equilibration. A somewhat less primitive portion, the paleocerebellar division of the corpus cerebelli, has mainly bulbar and pontine connections. Since its ablation produces exaggerated stretch reflexes and hypertonia of the antigravity muscles, it is mainly concerned with the postural tone and reflexes. The third portion, the neocerebellar division of the corpus cerebelli, has connections mainly with the cerebral cortex. It is concerned with the regulation of volitional movements and its ablation produces tremor, dysmetria, and asynergia. In primate monkeys and in man a permanent hypotonia is also produced. These facts are itemized and shown in more detail in the following outline:

THE DIVISIONS OF THE CEREBELLUM

I. The flocculonodular lobe (most primitive)
   a. Connections: vestibular nuclei
   b. Ablation produces: disturbances of equilibrium, such as swaying and staggering

II. Corpus cerebelli
   A. Paleocerebellar division
      1. Includes: Anterior lobe of corpus cerebelli (lingula, centralis, and culmen); paleocerebellar portion of the posterior lobe of the corpus cerebelli (pyramis, uvula, paraflocculus)
      2. Connections: reticular formation of the midbrain, pons, and medulla via the fastigial, globose, and emboliform nuclei; vestibular nuclei to slight extent
      3. Ablation produces: exaggerated stretch reflexes, and supporting reactions; augmentation of decerebrate rigidity; slight disequilibration
      4. Stimulation produces: inhibition of decerebrate rigidity; limb movements followed by rebound
   B. Neocerebellar division
      1. Includes: posterior lobe of the corpus cerebelli (simplex, ansiformis, paramedianus, declive, tuber)
      2. Connections: red nucleus, and thalamus via dentate nucleus and to some extent the globose and emboliform nuclei: fibers from the thalamus pass to the cerebral cortex
      3. Ablation produces: disturbances of volitional movements, including tremor, dysmetria, and asynergia; in the higher forms permanent hypotonia is produced
      4. Stimulation produces: no movements, but changes in cerebral activity

The neocerebellum is concerned with regulating volitional movements entirely. This relationship between the cerebellum and the motor cortex has recently received considerable attention. Aring and Fulton (46) observed in monkeys that ablation of the motor area of the cerebral cortex abolishes the tremor of voluntary movements which is produced by cerebellar ablation. Removal of the premotor area, on the other hand, exaggerates this cerebellar deficiency, and renders the animal incapable of compensating for the cerebellar deficit. Walker (47) has demonstrated anatomically the existence of a fiber tract which arises in the cerebellum and passes by way of the superior cerebellar peduncle to the thalamus, whence a second neurone extends to the motor cortex. Walker (48) has also presented physiological evidence for the existence of this pathway. He found that stimulation of the cerebellar hemispheres (neocerebellar) resulted in an increase in the frequency and amplitude of cortical action potentials recorded from the motor cortex. This effect was abolished by sectioning of the superior cerebellar peduncle. He expresses the view that the action of the neocerebellum is to lower the threshold of excitability of the motor cortex, a fact demonstrated years ago by Rossi (49). After removal of this "sensitizing" effect of the cerebellum the motor cortex will respond only to stimuli of high threshold and will give responses which are not nicely adjusted to the requirements. This would perhaps account for the delay in initiating reactions, the decomposition of movements, the tremor, dysmetria, and adiadochocinesia so characteristic of cerebellar lesions.

The paleocerebellum is present throughout the phylogenetic series and performs the same functions throughout. These functions are, to some

extent, the opposite of those of the neocerebellum. The greater development and predominance of the neocerebellum in the primates and man probably accounts for the fact that complete cerebellar ablation produces hypotonia in these forms in contrast to the opposite effects in cats and dogs.

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ABSTRACTS OF CURRENT LITERATURE

SURGERY OF THE HEAD AND NECK

HEAD

Jones, W. A.: Further Observations Regarding Familial Multilocular Cystic Disease of the Jaws. *Brit. J. Radiol.*, 1938, 11: 227.

The writer of this article describes a form of multilocular cysts occurring in 4 children of the same family, and compares these disorders to a similar one in another patient, the description of which was put at his disposal by Thomas of Savannah, Georgia.

The disorder described affects both the mandible and the maxilla simultaneously, causes a bilateral protuberance of the cheeks and jaws and a slight fullness and upward turning of the eyes, revealing the white sclera beneath. This gives the children a peculiarly grotesque, cherubic appearance which induced the writer to coin the word "cherubism" to give the condition a name. Associated with this bony expansion is a swelling in the submaxillary regions which is caused by hyperplasia of the lymph glands, and comes on in the early stage of the affection and later disappears.

In the oldest child thymic attacks were observed, which cleared up under x-ray therapy. The second child at the age of five showed a rather marked secondary anemia, was listless and felt somewhat ill when her lymph glands became enlarged; there was, however, no rise in temperature and no change in the white blood count. The other children remained healthy and active while the disease developed. Wassermann reactions were negative. In the oldest boy serum phosphorus and phosphatase showed an increase, while the blood chemistry remained normal in the youngest child.

The parents of the author's patients were of the Hebrew race and of Russian ancestry; they had 5 children of whom 4 were affected, but there was no evidence of a like condition in the previous generation. Thomas' patient was a boy aged eleven, with multiple cysts in both jaws, but with no glandular involvement. His family history, however, was of interest. A genetic chart included in this article showed the descent of the anomaly through 5 generations.

The Hebrew children were aged twelve, eleven, ten, and seven years, and eighteen months; all were boys except the second. The 3 older children were under observation for six years. The child aged seven was not affected and the child eighteen months old was just about to show the effect of the disease, which seemed to begin to present symptoms from the end of the second to the end of the third year of life.

The roentgenograms of the older children taken six years ago show a polycystic condition affecting

Fig. 1.

practically the entire mandible as well as the maxilla. The small osteolytic areas making up the multicystic condition shown at that time became enlarged during the course of the disease, and after six years the roentgenogram showed enlargement of the individual cysts, a decrease in the thickness of the intervening bone septa, and marked expansion of the cortex. The roentgen examination also showed many retained and irregularly placed teeth, although some were shed during the time of observation. Radiographic examination of the skull, chest, and other bones revealed no evidence of any abnormality.

Pathological examination was made only on an excised lymph gland. It showed diffuse fibrous overgrowth and marked endothelial proliferation in the sinuses.

The writer considers the condition as an anomalous development of dental structure with formation of cysts, some of which contain teeth, while others do not contain teeth and are presumably formed from proliferating enamel epithelium which has failed to produce a tooth anlage and degenerated instead into a cyst membrane. There has been no pathological examination made of tissue excised from the jaws, and other diagnoses suggested by the writer, such as adamantinoma and fibrocystic disease, while unlikely, cannot be definitely excluded.

Therapy should, according to the writer, be confined to orthodontic treatment of the erupted teeth. For the jaws he recommends mastic inactivity, and for posterity sterilization of the carriers of these abnormal genes. KURT H. THOMA, D.M.D.

EYE

Reese, A. B.: Precancerous Melanosis and Diffuse Malignant Melanoma of the Conjunctiva. *Arch. Ophth.*, 1938, 19: 354.

Precancerous melanosis may occur in a previously normal conjunctiva, followed by diffuse malignant melanomas. Eight such cases are reported in detail.

The average age at which the lesion was first noticed was forty-eight, and the average time before malignant changes occurred was five years. The precancerous areas were always diffuse and sometimes involved almost all of the conjunctiva. Severe inflammation sometimes accompanied the increase in size and pigmentation of the growing lesions, as is the case with an analogous condition of the skin.

During the precancerous stage, irradiation with radon tubes may be effective, but the treatment of choice is early exenteration since much of the conjunctiva is involved. A Thiersch graft should be applied to avoid a long series of dressings.

SAMUEL A. DURR, M.D.

Tooke, F. T.: A Melanoma of the Iris with Pathological Findings. *Brit. J. Ophth.*, 1938, 22: 153.

The author gives a very good historical account of melanoma of the iris, and a most interesting case report of a young medical student who was required to make a very difficult differential diagnosis of this condition.

He states that the question has been not so much the clinical history of the case and its subsequent behavior following operative interference, but rather the genesis of the hyperplasia of pigment-producing cells, the origin and character of these cells, and rôle they play in the formation of what some regard as a simple hyperplasia of pigment cells, and others, as a true tumor. The argument regarding the derivation of the cells responsible for pigmented growths has been waged by authorities of undoubted reputation, but apparently the end is not yet.

The opinions advanced up to date regarding the origin of these cells are as follows:

1. They arise from the epithelium, or are epiblastic in origin (Unna, Kromeyer, Marchand, Gilchrist).
2. They are mesoblastic in origin and are:
   a. Young connective tissue cells (Simon, Kirchow, Riecke),
   b. The result of proliferation of the lymphatics (von Recklinghausen, Lubarsch, Herxheimer),
   c. Growths from the endothelium and perithelium of the blood vessels (Pick, Jodasshon), or
   d. Growths from the sheaths of the nerve fibers (Soldau).

The development of the iris is partly from epiderm and partly from mesoderm; each part has its own particular system of pigment cells. The cells in the anterior portion of the iris, or the mesodermal portion, are analogous to the pigmented cells of the choroid; they are generally termed "chromatophores." However, they are more precisely termed "mesodermal melanoblasts" and correspond to the cells encountered in Mongolian spots of the skin. They are "dopa" positive, at least in embryonic life, and apparently may vary in their "dopa" reaction and manifest in this way a dual function.

In contrast to the mesodermal melanoblasts we have the "ectogermal melanoblasts" which occur on the back of the iris, and are an extension of the retinal epithelium. They are ectodermal in origin and analogous to the pigment of the epidermis of the skin.

Tumors in this retinal layer, as those in the epidermal derivations of the skin, take the form of pigmented papillomas or warts. They frequently occur in the horse and may protrude into the pupil, as Treacher Collins has shown. Some authors refer to them as melanomas or as papillary epitheliomas of the inner layer of the iris. Their cells are large and epithelial in character, and differ in form from the spindle or fusiform shape of the mesodermal melanoblastic elements. The growths are true tumors with supporting blood vessels and stroma.

LESLIE L. MCCOY, M.D.

EAR

Lindsay, J. R.: Suppuration in the Petrous Pyramid. *Ann. Otol., Rhinol. & Laryngol.*, 1938, 47: 3.

The author states that meningitis of otitic origin is common in comparison to meningeal infections of other origin. Of 28 cases of meningitis of all types from which the necessary pathological material could be obtained, 15 cases occurred in the course of acute otitis media. The next most frequent type was tuberculous meningitis, of which there were 5 cases in the group; while infection of the frontal and sphenoid sinus each accounted for 2 additional cases of meningitis.

In 9 of the 15 cases, the route by which the infection traversed the temporal bone and invaded the meninges could be traced definitely by a histopathological examination. Two cases could not be considered because the parts of the temporal bones which had been removed at autopsy were inadequate for study. In the remaining 4 cases it was possible to rule out any direct spread of suppuration through the petrous pyramid, either by means of pneumatic spaces or through the bone marrow. It seems probable that the meningeal infection may have been hematogenous in origin in these 4 cases, and in 2 of them a concurrent pulmonary infection was probably the source of a blood-stream invasion.

It was found in every instance that the predominating pathological lesion was a suppurative process within pneumatic spaces, which had produced destruction of cell partitions and had eroded through the cortex, either directly or along preformed vascular channels in the bone, to the middle or posterior cranial fossa, or both. In nearly every instance considerable osteogenesis had occurred in the granulation tissue, both in the lining of infected pneumatic spaces and in adjacent marrow spaces, as

well as in the granulating walls of the abscess cavity and on the inner surface of the bony cortex beneath the dura. JAMES C. BRASWELL, M.D.

NOSE AND SINUSES

Larsell, O., Veazie, L., and Fenton, R. A.: Streptococcic Infection of the Lungs from the Paranasal Sinuses: An Experimental Study. *Arch. Otolaryngol.*, 1938, 27: 143.

Recent experimental studies have shown that probably the most important pathway of infection from the nasal accessory sinuses is a route combining the lymphatic and blood vessels from the sinuses to the pulmonary capillary bed via the right side of the heart. These conclusions were reached following the injection of trypan blue into the sinuses under conditions which precluded the tracheal pathway to the lungs. Later, the dye was found in phagocytes in the lungs and at various points along the route indicated.

The present experiments were undertaken to determine if cultures of streptococci introduced into the sinuses followed the same route in animals as in man.

The material consisted of rabbits and cats and, as a rule, inoculation was made into the frontal sinuses or into the paralaryngeal lymph node which drains these sinuses. Some of the animals were killed, others died at varying intervals, and at autopsy most of the animals showed evidence of infection. Only when the beta streptococcus was found was the evidence deemed positive. The histological study showed these organisms to be virtually absent from the bronchial passages, but they were present in the parenchyma and in the lymphatic vessels.

Viable streptococci, as shown by bacteriological methods, can reach the lungs from the paranasal sinuses and the related regional lymph nodes.

The number of organisms which reach the lung is much smaller when the sinuses are inoculated than when the bacteria are introduced directly into the paralaryngeal lymph nodes, which serve as filters for the lymphatic stream from the sinus region.

The fact that streptococci reach the lungs, liver, and spleen from the paralaryngeal lymph nodes when either the sinuses or lymph nodes are inoculated, indicates that the anatomical pathway must be via the paratracheal lymphatic vessels to the great veins and thence into the right side of the heart and into the pulmonary capillary bed. From this point they may reach the pulmonary tissues or may be carried by the blood stream to other parts of the body. Most of the organisms that pass through the lungs are apparently filtered out of the blood stream by the spleen and by the Kupffer cells of the liver. JOHN F. DELPH, M.D.

Malan, E.: Surgery of the Osteomas of the Facial Sinuses (Chirurgia degli osteomi delle cavità pneumatiche perifacciali). *Arch. ital. di chir.*, 1938, 48: 1.

Osteomas should be considered as true tumors. They should be differentiated from ossifying tumors in which the ossification is merely an epiphenomenon in the development of the tumor, and from hyperplastic and hypertrophic forms of ossification, exostoses and hyperostoses.

Osteomas vary in size from a pea to an egg or larger. They develop very slowly at the beginning. Growth proceeds from the nucleus of origin. Occasionally other nuclei develop and give rise to a knobby growth. The shape of these tumors is also determined by the shape of the cavity in which they grow. The tumor usually molds itself in the sinus; following the path of least resistance it breaks through osseous partitions into other adjoining sinuses or cavities. In this manner dumbbell-shaped tumors arise, and in these recurrence is possible if the primary segment is not removed.

Histologically, osteomas are covered by a layer of ciliated paranasal epithelium, and periosteum. The tumor proper is composed of varying amounts of spongy, compact or eburnated bone, and is named according to the chief component. The older the tumor is, the harder its composition. The peduncle from which the vessels supplying the growth issue is always made of spongy bone. The mucosal covering of the tumor is subject to the pathological changes of nasal mucosa in general. Mucosal cysts and polypoid changes are to be considered as concomitant occurrences and not due to the presence of the tumor. Osteomas of different structural makeup have been described: osteoblastoma, osteo-angioma, osteo-myxoma, cartilaginous inclusions, chondro-osteoma, and osteofibroma. These should be considered as transitory forms of osteomas, heterotopic ossifications, or bony tumors in which the prevalence of one tissue has altered the structure of the bone. Osteomas do not become malignant.

Osteomas usually initiate their growth at puberty. They probably arise from residual embryonal rests. The cause of the first impulse to growth is not known. It is established, however, that trauma and infection of the nasal mucosa are important in initiating the growth. Osteomas grow very slowly

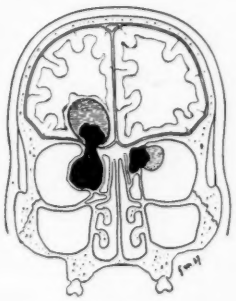

Fig. 1.

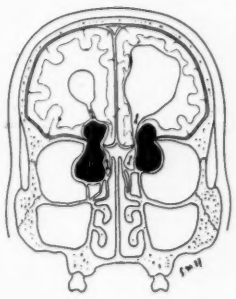

Fig. 2.

Fig. 1. Schema of the formation of an ethmoidal orbital mucocele (right), and of an ethmoidal cranial mucocele (left). Fig. 2. Schema of the formation of intracranial (right) and intraventricular (left) pneumatocele.

and irregularly until they are attached to their point of origin by a stalk or peduncle. The zone most easily invaded by these osteomas is the orbit, because on this cavity all the other nasal cavities border, and because its walls offer little resistance to the invading tumor. At times the main body of the osteoma detaches itself from its stalk and lies free, as a foreign body in a cavity.

The frontal sinus is most commonly involved near the anterior pole of the ethmoid sinus. In the early stages the tumor occupies the sinus without deforming it, and it can be diagnosed only with x-rays or by means of concomitant infection or closure of the nasofrontal duct. As the tumor grows the walls of the sinus become deformed. The wall nearest the tumor is first involved. The most frequent directions of growth are toward the opposite side, toward the orbit, and toward the cranium. During the period of deformation the symptoms are those of skeletal changes of the frontal bone, which are sometimes visible, and pain due to compression of nerves or meningeal irritation. When the tumor invades other cavities symptoms of invasion of these cavities occur.

The ethmoid sinus is involved about one-third as frequently as the frontal sinus. Osteomas in this sinus easily break through the lamina papyracea and invade the orbital cavity.

The sphenoid sinus is the least frequently involved. Most cases are small osteomas of spongy. makeup. However, some very large sphenoid osteomas invading other cavities as well as the cranium have been described.

The maxillary sinus is involved less frequently than the frontal or ethmoid. The early development of the tumor is asymptomatic. As it exteriorizes facial distortion takes place. The palate may be modified or eroded. The pterygomaxillary fossa may be involved as well as the orbit or nasal cavity. Cases of a free tumor in the maxillary cavity have been described; and also cases in which tumors were found in both sides.

Osteomas of the nasal cavities are rare. They are usually extensions from the sinuses. Occasionally they arise from the nasal septum, from the inferior cornu, or from the palate including the pterygoid uncus. In these cases the tumor usually projects into the pharynx.

The frequency of osteomas of the orbit has not been definitely established. More than half of the cases are invasions from the frontal, sphenoid, or maxillary sinuses. Many other cases are exostoses or hyperostoses, or manifestations of general or local bony diseases.

The subjective symptoms of osteoma of the sinuses include:

1. Pain. Initially the pain is occasionally neuralgic in character, intermittent, rarely constant, frequently irradiating, and very difficult to localize. Later the pain becomes localized. It is due to the compression of nerves by the tumor. In the maxillary sinus, the infra-orbital nerve is involved, while in the frontal and ethmoid sinuses the supra-orbital and nasociliary nerves cause the pain. When the nasociliary nerve is compressed the syndrome of Charlin results. Pain may also arise from the formation of a vacuum in the frontal sinus, formation of a mucocele, or by occlusion of the frontonasal duct.

2. Headache. This symptom is frequent. At the beginning it is moderate and intermittent, while later it is severe and constant. A very severe headache is usually caused by invasion of the cranium. When the headache is accompanied by rhinorrhea, fracture of the skull and pneumatocele should be suspected.

3. Respiration. Difficulties in respiration are rare. Large osteomas in the nasal cavities may not cause any respiratory symptoms, while occasionally small osteomas reflexively cause severe difficulties in breathing.

4. Ocular symptoms. Diplopia is not infrequent; it is due to the exophthalmos, or to involvement of ocular nerves or muscles. Occasionally diminution of vision from a compression retrobulbar neuritis is seen.

5. Other symptoms. These are rare and include dysphagia, psychic symptoms, and anosmia.

Inspection will show facial disfigurement when present. Osteomas of the frontal and ethmoid sinuses frequently cause variable tumefactions in the superior-internal angle of the orbital margin, on the squama of the frontal bone, or at the root of the nose. Palpation of the skin over these tumefactions is not painful. The skin is freely movable over the smooth or knobby mass. Rhinoscopy may show an intranasal mass of whitish or ivory color, denuded, or covered with mucosa, and hard as ascertained by instrumental palpation. Anterior rhinoscopy shows the bone deformities caused by the tumors. Illumination may show opacities in the sinuses. Hemorrhages are rare. The sense of smell should be tested. Exophthalmos is the most characteristic symptom of the frontal, ethmoid, or other sinuses. The osteoma in its development pushes the globe anteriorly and downward, or laterally. In the early stages it is very difficult to discern the exophthalmos. It is always unilateral and non-pulsating. Various grades of keratitis, panophthalmitis, and chemosis may accompany the exophthalmos. Alterations in the ocular movements due to nerve or muscle compression may be demonstrated. The visual disturbances vary from a mild amblyopia to amaurosis, and are caused by compression retrobublar neuritis. The ophthalmoscope may show optic atrophy. Anisocoria, due to compression of the ciliary nerves, ptosis, epiphora, and conjunctivitis, may also be found. When the osteoma extends upward and invades the anterior cranial fossa signs of frontal-lobe compression occur. The most typical of these signs are jacksonian attacks. Other objective neurological signs are usually absent. (Encephalography may show distortion of the anterior horns of the ventricles, and fine tests may bring out visual and olfactory disturbances.) With the growth of the osteoma

Fig. 3 (left). Denker's operation for the maxillary sinus.
Fig. 4 (right). Killian's operation for the frontal sinus.

Fig. 5 (left). Kuhnt's operation for the frontal sinus.
Fig. 6 (right). Transmaxillonasal operation of Moure.

the meninges may be perforated and give rise to meningitis or brain abscess. Of all the examinations the radiological is the most essential because it is the most positive and indicates the surgical approach. Postero-anterior and lateral films should be taken routinely while occasionally special projections are indicated. On the films osteomas present themselves as very dark shadows clearly delineated. Their relation to the sinus walls is usually clearly seen and the peduncle is often visualized.

Complications of osteomas are due to the direction of the growth of the tumor and not to its size. Large osteomas may not cause any complication, while small ones with intracranial encroachment may prove fatal. Within the sinuses the most frequent complications are sinusitis, mucocele (Fig. 1), and vacuum sinus. Intracranial complications include meningitis, extradural abscess, cerebral abscess and extradural, intracerebral, and ventricular pneumatocele (Fig. 2).

The only therapy for osteoma is surgical removal. This, however, is not immediately indicated in all cases. Many cases are asymptomatic and discovered accidentally by x-ray examination. These do not give any annoyance to the patient and are not dangerous to his health and should not be removed. Immediate removal of these tumors is also contraindicated by the fact that some cases show permanent arrest of development. Operative indication becomes positive only when signs of invasion or facial disfigurement are present. When extirpation is undertaken it must be complete to avoid recurrence. The operative procedures include intranasal, transnasal, transorbital, and transcranial methods.

Indications for the intranasal method are rare. Only nasal and small ethmoidal osteomas easily enucleable can be removed by this approach.

1. Under the transnasal methods are: the Caldwell-Luc operation; after gingival-buccal incision exposes the canine fossa, removal of its wall exposes the maxillary sinus.

2. Denker's operation (Fig. 3). Exposure of the canine fossa is obtained as in the previous operation, but more extensively in order to expose the anterior (superior) angle of the pyriform nasal aperture. Together with the anterior wall of the maxillary sinus, this angle and part of the medial wall of the maxillary sinus are removed.

3. Killian's operation (Fig. 4). An incision is made along the supra-orbital line and prolonged toward the root of the nose. The frontal and orbicular walls of the sinus are removed and only a small bridge of bone corresponding to the orbital margin is left. The frontal process of the maxillary bone is removed and the superior ethmoid is destroyed.

4. Kuhnt's operation (modified) (Fig. 5). The incision is the same as in the Killian operation. The anterior wall of the sinus including a part of the orbital wall is removed, the frontal process of the maxillary bone is resected; and a nasofrontal canal widest across the anterior ethmoid is formed.

5. Moure's operation (Fig. 6). Paralateronasal rhinotomy. The nasal bone of the same side is resected and the nose is bent to the opposite side. The frontal process of the maxilla is removed so as to open the maxillary and ethmoid sinuses. Through this breech the maxillary, ethmoid, and sphenoid sinuses can be approached. The incision can be extended above to open the frontal sinus and the orbit and also downward with splitting of the upper lip to expose the canine fossa and the palate.

The transorbital method is used in Cirincione's operation. A long deep incision is made along the internal margin of the orbit and the medial third of the superior margin. Subperiosteal exposure of the medial and part of the superior walls of the orbit is obtained by pushing the eyeball externally. The subperiosteal route is essential in order that the trochlea may be saved.

In the transcranial method a frontoparietal osseocutaneous flap is turned and the frontal lobe is lifted to expose the superior wall of the orbit and frontal sinus, and these walls are demolished in order that the tumor may be exposed and removed. Reduction of the intracranial pressure is essential for a good exposure. This is accomplished either by means of ventricular puncture after the flap has been turned, or, better, by continuous spinal drainage during the preparation of the patient and turning of the flap. After the brain has been exposed the spinal needle

may be withdrawn. The transcranial approach is safe, and in the cases so far reported there has been no intracranial infection from sinus infection. When sinus infection exists the transcranial operation should be delayed until the infection clears up.

The article contains an extensive bibliography of 18 pages. DAVID IMPASTATO, M.D.

NECK

Giordanengo, G.: Clinical Characteristics and Anatomicopathological Features of Acute Non-Suppurative Thyroiditis (Caratteristiche cliniche ed anatomopatologiche della "tiroidite acuta non suppurativa"). *Minerva med.*, 1938, 29: 353.

According to the author, acute non-suppurative thyroiditis is perhaps the rarest inflammatory condition of the thyroid gland and the least known. The thyroid gland is notoriously very resistant to infection and to inflammatory involvements mostly because of its great vascularity and high iodine content. However, in the presence of goiter, and especially nodular goiter, this resistance toward infection tends to be decreased. According to Manniger, the cause of acute non-suppurative thyroiditis may include the following factors: (1) a decreased vascularization; (2) a tendency to hematomas; (3) the appearance of degenerative changes; and (4) atheromatous and sclerotic changes of the capsular vessels.

The first detailed description of the condition was given in 1904 by De Quervain. From 1904 to 1936 there have been reported altogether 54 cases in the literature. The condition is encountered especially in countries in which goiter is endemic. It affects women chiefly and is observed most frequently in adolescence and in middle life. As the age advances, the incidence decreases.

Symptomatically, the onset is sudden and is characterized by the appearance of a tumefaction accompanied by considerable pain, which may be spontaneous or may be elicited by the slightest pressure. Because of the pain, the head is held in a characteristic position which is maintained throughout the acute phase of the disease. There are usually difficulties in deglutition and there is inspiratory stridor and hoarseness due to involvement of the recurrent laryngeal nerve. Fever may be present and in some cases clinical signs of hyperthyroidism may supervene. Usually the course of the disease is prolonged for about ten days, after which time the subjective and objective symptoms gradually disappear.

The diagnosis is not difficult if the physician is familiar with the condition. The disease is to be differentiated from tuberculosis, syphilis, and malignant neoplasm of the thyroid gland. It should also be differentiated from acute suppurative thyroiditis, which is characterized by pain, muscular rigidity, fluctuation due to the presence of pus, and enlargement of the cervical lymphatics. The prognosis of acute non-suppurative thyroiditis is favorable. In a series of 125 patients, the condition was followed by myxedema in only 2 cases. Hyperthyroidism occurs more frequently as a sequel and has been observed in about 8.8 per cent of the cases.

Therapy is strictly conservative and symptomatic. Surgical interference does not prevent recurrences.

Anatomicopathologically the condition is characterized by (1) proliferation, detachment, and degeneration of the epithelial cells lining the alveoli; (2) changes and progressive disappearance of the colloid; (3) polymorphonuclear-lymphocytic and macrocellular (transformed connective-tissue cells?) infiltration into the alveoli and formation of giant cells around unabsorbed portions of colloid; and (4) the appearance of organized connective tissue.

Little is known concerning the cause of the disease. From a statistical study of his own series of cases, the author is inclined to believe that in many cases the disease is secondary to severe systemic infections such as scarlet fever, typhoid fever, and acute articular rheumatism. Some cases have been reported to have followed a tooth extraction, epidemic parotitis, puerperal infections, and postoperative abdominal abscess. The so-called primary forms of the disease are believed to be clinically related to rheumatic fever. Indeed, Vincent believes that tenderness and swelling of the thyroid gland constitute pathognomonic signs of rheumatic fever.

Bacteriological examinations, unfortunately, have not yielded any conclusive results. It is thus assumed that this process within the thyroid gland is due to the action of a toxin rather than to the action of pathogenic micro-organisms present in the gland.

RICHARD E. SOMMA, M.D.

INTRASPINAL TUMORS; SURGICAL CONSIDERATION

Collective Review

ALFRED W. ADSON, M.D., F.A.C.S., Rochester, Minnesota

PRIMARY (4, 34) intraspinal tumors are usually benign and operable, and are much more common than they are usually thought to be. These facts justify a review of the symptoms produced by and the newer methods employed in the differential diagnosis of these tumors in order that they may be recognized and removed before complete paralysis results (1, 3). These tumors may arise from all the primary tissues of the spinal canal and are about equally distributed from the cervical cord to the sacral nerves (10, 12, 13). Those that arise from the nerve roots or meninges produce characteristic root pains (11), which unfortunately are frequently unrecognized, and patients are subjected to various surgical measures without avail (Fig. 1).

The first successful operation was performed by Sir Victor Horsley (2). The patient was a man, aged forty-two years, who had suffered from intercostal pain for three years. Four months previous to operation the lower extremities became weak; the weakness progressed to complete paraplegia and anesthesia below the level of the sixth and seventh thoracic roots. Severe tonic spasms occurred in the legs, and paralysis of the bladder and rectum was also present. At operation, a fibromyxoma, situated at the level of the third and fourth thoracic vertebræ, was removed. Improvement was gradual, terminating in cure within one year. Since Horsley's time, many men have contributed to the literature on the diagnosis and treatment of intraspinal tumors, and I wish space would permit an abstract of the various discussions. The monumental pioneer work of Elsberg (17) and Frazier (20) in this country has served as a stimulant and for guidance to many of us who are attempting to carry on with the treatment of intraspinal tumors.

Etiology. The specific cause of tumors of the spinal cord remains unknown. However, the same factors that are responsible for tumors in other parts of the body probably pertain to the development of tumors within the cord and meninges. Intraspinal tumors rarely develop in childhood (the youngest patient in our series was aged seven years), although tumors have been reported as early as the twenty-second month of life. The third, fourth, and fifth decades of life are the ages at which most of the tumors occur (Table I).

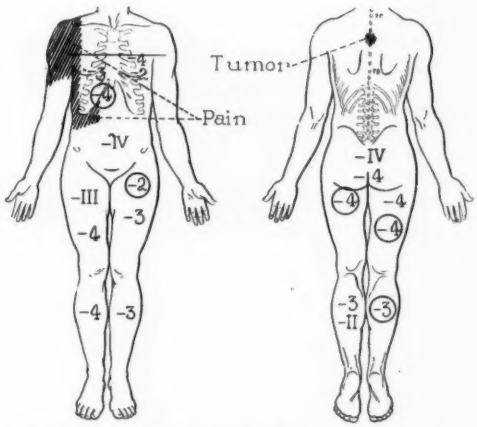

Fig. 1. Situation of root-pain with subsequent loss of motor and sensory functions.

TABLE I.—AGE INCIDENCE AND SITUATION OF 451 TUMORS OF THE SPINAL CORD OPERATED ON AT THE MAYO CLINIC UP TO OCTOBER, 1935

Age, years	Extradural	Intradural		Total
		Extramedullary	Intramedullary	
1 to 10	1		1	2
10 to 20	12	2	6	20
20 to 30	23	33	27	83
30 to 40	28	59	29	116
40 to 50	25	53	28	106
50 to 60	24	54	17	95
60 to 70	7	17	4	28
70 to 80		1		1
Total	120	219	112	451

Section on Neurologic Surgery, The Mayo Clinic.
Submitted for publication March 31, 1938.

TABLE II.—DISTRIBUTION BY SITUATION OF 451 TUMORS OF THE SPINAL CORD

Portion of cord	Extradural	Intradural		Total
		Extramedullary	Intramedullary	
Cervical	19	29	19	67
Cervicothoracic	8	13	14	35
Thoracic	59	111	49	219
Thoracicolumbar	10	25	18	53
Lumbar	18	32	5	55
Lumbosacral	5	6	2	13
Sacral	1	3	5	9
Total	120	219	112	451

It is doubtful if trauma is a predisposing factor unless it is responsible for the development of osteomas, fibromas, and ecchondromas in the intervertebral discs. Trauma, as well as chronic infection, may be responsible for hypertrophic osteitis which produces radiculitis and slowly progressive myelitis, simulating the symptoms of intraspinal tumor. In cases in which malignant tumors were present in some part of the body, metastatic malignant growths have been reported to have occurred in the spine after injuries to the back.

Pathology. In a review (19, 24, 26, 35) of 451 verified cases of intraspinal tumor in which patients were operated on at The Mayo Clinic (Table II), it will be observed that 120 of the tumors were situated extradurally, and that 219 tumors were found to be situated intradurally but extramedullary. In 112 cases the lesion arose from the structures of the spinal cord or filum terminale.

"Further classification of the tumors, according to pathologic structure and the tissue involved, was made by Kernohan and Craig (9) (Table III). Craig, in his recent article on 'Tumors of the Spinal Cord,' has grouped the tumors according to the pathologic classification. His study revealed that there were 112 neurofibromas (23) (perineural fibroblastomas), 81 of which were attached to the nerve roots within the dura and 26 of which arose extradurally and extended into the canal; the remaining 5 originated in the nerve filaments as they left the cord. Craig has stated that it was not infrequent to find these tumors extending from within the dura to the extradural space, or extending from the extradural to the intradural space, thus producing what is commonly referred to as a 'dumb-bell' tumor (32, 33).

TABLE III.—TISSUE CHANGES THAT CAUSE COMPRESSION OF THE SPINAL CORD

Of extrameningeal origin	Arch of vertebra	Hypertrophic osteitis
		Benign giant-cell tumor
		Osteoma
		Chondroma
	Body of vertebra	Carcinoma, metastatic
		Osteosarcoma
		Benign giant-cell tumor
	Intervertebral disc	Chondroma
		Fibrochondroma
		Fibromyxochondroma
		Chordoma
	Extradural fat	Abscess
		Lipoma
		Lymphosarcoma
		Fibrosarcoma, metastatic
		Hypernephroma, metastatic
		Cholesteatoma
	Spinal nerves	Neurofibroma
	Blood vessels	Hemangioma
		Hemangio-endothelioma
Of meningeal origin	Extradural	Tuberculoma
		Fibroma
		Pachymeningitis
	Intradural	Endothelioma (meningeal fibroblastoma)
		Hemangioma
		Neurofibroma
		Cystic arachnoiditis
		Varicosities
Of medullary origin	Tissue of the cord	Fibroma
		Ependymoma
		Glioma
		Angioma
		Endothelioma
		Fibrolipoma
		Hemangioma
	In the cord but not of its tissues	Cysts, including syringomyelia and dermoids
		Abscesses
		Malignant metastatic growths

"Endotheliomas (meningeal fibroblastomas) numbered 219 out of the 415 tumors, or approximately one-half of the entire group. These tumors are non-malignant, definitely encapsulated, and are easily removable. Since most of them arise from the arachnoid, become adherent, and may extend into the dura, it is therefore important to remove the involved meninges in order to prevent recurrence. Many of the extradural tumors, as well as the tumors arising in the filum terminale, are operable. Tumors within the spinal cord are rarely removable, but it is possible to decompress the cord by incising it in the midline over the tumor. Such a procedure permits partial removal of the tumor, and extrusion of the tumor permits of relief of pressure on fiber tracts that are not involved.

"Laminectomy and partial removal of nonencapsulated lesions may offer relief from compression of the cord in a variety of neoplasms, but it is not indicated for metastatic lesions because the relief obtained is usually of too short duration before other metastatic growths appear to justify the surgical procedure."

Since October, 1935, operation has been performed at the clinic for 98 additional intraspinal tumors. Seventy-four of these were extramedullary and 20 intramedullary; in addition, 3 were tumors of the filum terminale and 1 was in the sacrum. During this same period, we have also operated on 131 patients who had ruptured intervertebral discs (27, 28, 30), with prolapse of the nucleus pulposus into the spinal canal (31). This gives us a total count of 680 verified intraspinal tumorous lesions, including the protruded intervertebral discs, but it does not include metastatic lesions of the spine.

Symptoms. Tumors (16, 39, 40) which arise from the tissues surrounding the spinal cord have been designated as "extramedullary," in contrast to those which arise in the cord itself, which have been called "intramedullary." Oppenheim and Frazier have divided the symptoms of extramedullary tumors into three phases. The first phase is involvement of the nerve roots; the second, beginning compression of the spinal cord; and the third, extreme compression of the spinal cord, producing the clinical picture of transverse section of the cord.

The outstanding symptom of involvement of the nerve roots is pain which is usually characteristic and pathognomonic. It may precede any other symptoms by months or years; it may be constant or intermittent, persist in a localized region, and radiate over the involved nerves. It is usually lancinating and is aggravated by coughing, sneezing, lifting, and straining at stool, and it invariably awakens the patient from four to six hours after he has retired. It often becomes so severe as to compel the patient to walk the floor or to sleep in a sitting position. The mechanism that produces this pain apparently is the ball-valve action of the tumor, which is forced downward by the increased pressure of the cerebrospinal fluid above it, and thus produces traction directly or indirectly on the nerve roots. Unfortunately, many of these patients are treated for neuritis, muscular rheumatism, or syphilis, and some have been thought to have had hysteria. The importance of recognizing or suspecting the first, or painful, phase in the development of tumors of the spinal canal was emphasized in a recent survey by Craig (9) in which he states

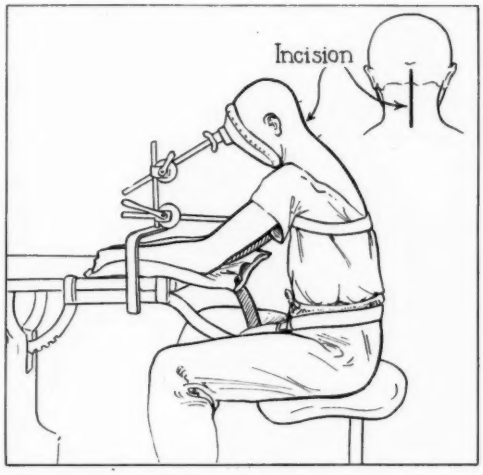

Fig. 2. The upright position employed for cervical laminectomy.

that 10 per cent of the patients who had root-pain had been operated on for some thoracic or abdominal lesion other than an intraspinal tumor.

When the tumors occur in the cervical region of the cord (5, 37), the pain may be localized in the neck or extend to the occiput or to the shoulders, and depends on the localization of the tumor. It is increased by laughing, sneezing, or coughing, and may be accompanied by some rigidity of the neck.

Tumors in the thoracic region produce pain which frequently simulates intercostal neuralgia, cholecystitis or cholelithiasis, renal colic, or even appendicitis.

Tumors of the cauda equina and the filum terminale in the lumbar and sacral regions give rise to pain which simulates that of sciatica (29). Again, the pain may persist for months before signs of compression are manifest. Rupture of the intervertebral disc, with prolapse of the nucleus pulposus in the lumbosacral region, according to Love and others, is also characterized by symptoms of chronic recurring sciatica. The usual neurological signs consist of a positive Lasègue sign and a diminished Achilles reflex. Intraspinal studies are necessary to verify the diagnosis.

The symptoms which develop in the second symptomatological phase, the phase of beginning compression of the spinal cord, differ from those of the first phase in that neurological evidence of compression of the cord now becomes evident.

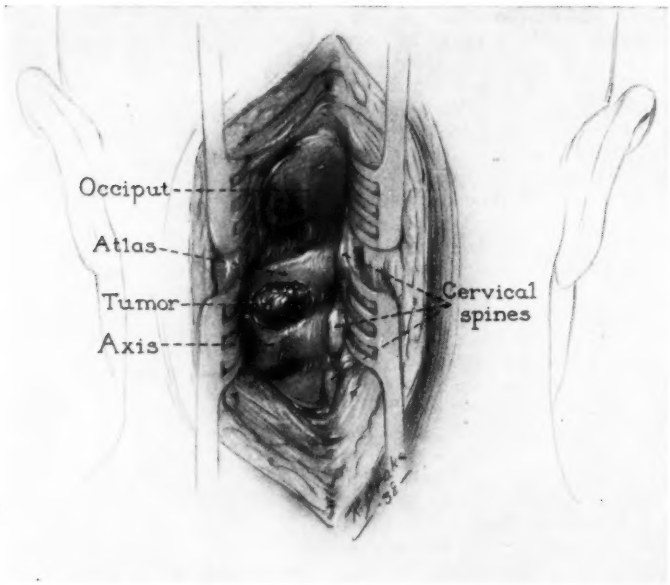

Fig. 3. Exposure of a dumb-bell neurofibroma by unilateral laminectomy.

The symptoms may develop simultaneously with the existence of pain, or they may develop without the presence of pain in a small percentage of cases. If the tumor is situated anterolaterally, the symptoms will progress and produce the Brown-Séquard syndrome: a homolateral paralysis of the muscles below the level of the lesion with impairment of tactile and deep sensibilities on the same side together with loss of, or diminution of, the sensation of pain and temperature on the opposite side. If the posterior columns of the cord are the first to be compressed by tumor, the deep sensibility is decreased and ataxia appears. Sensory disturbances resulting from compression of the cord are gradual in onset and progress upward to a transverse level corresponding to the segment of the cord that is compressed.

At the lower end of the spinal cord, other difficulties may be encountered. The relative shortening of the cord incident to growth, and the emergence of the roots through the anterior foramina of the sacrum often make it extremely difficult to determine whether there is a tumor of the conus medullaris, of the cauda equina, or of the sacrum. The objective findings may be the same. In this group, studies with lipiodol are found to be valuable in the localization and differentiation of the lesion.

Paralysis below the level of the tumor comprises the third symptomatological phase, and is caused by extreme compression of the cord. The paralysis is usually complete, sensory functions are entirely lost, trophic disturbances are present, and there is definite loss of control of both vescial and rectal sphincters.

Intramedullary tumors. These rarely produce pain, and pass directly into the second symptomatological phase. The sensory and motor disturbances are progressive until a definite transverse level becomes evident. The upper sensory level is less distinct than that produced by extramedullary tumors. Increased reflexes and loss of vesical and rectal control appear early in the symptom complex.

Examination. The symptoms which play important parts in the diagnosis of intraspinal lesions emphasize the necessity of a comprehensive history in all cases. Following the taking and recording of the history, a detailed general, as well as a neurological, examination is necessary. These examinations should include such special features as spinal puncture, Queckenstedt studies, and roentgenograms of the spinal column, with or without the introduction of iodized oil.

General examination. In all cases in which intraspinal lesions are suspected, close inspection

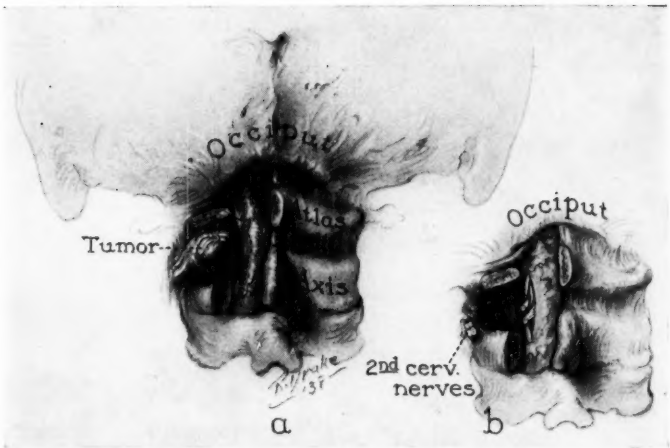

Fig. 4. Removal of tumor illustrated in Figure 3. *a*; Left unilateral laminectomy exposing tumor; *b*, surgical field following removal of tumor.

of the skin of the body is necessary for evidence of cutaneous fibromas or pigmented patches of von Recklinghausen's disease. This general view allows for comparison of the size of the two arms and the two legs, as well as for detection of muscular fibrillation and of atrophy of isolated sets of muscles.

Primary malignant growths of the abdominal and pelvic viscera should be kept in mind in examination of elderly patients, and the urine should be examined for evidence of renal tumors. Rectal palpation should be done for the detection of malignant growths of the pelvic organs, rectum, prostate gland, and for growths from the sacrum.

Neurological examination. In the case in which tumor of the spinal cord is suspected, there is no investigation so important as a complete neurological examination. The information elicited by a detailed testing of the reflexes, muscular strength, muscular tonus, sensory acuity, gait, co-ordination, and balance tends to distinguish between degenerative diseases and the syndrome of compression of the cord.

Spinal puncture. This examination is very important, because it reveals information concerning the physical and hydrodynamic properties of the spinal fluid, and allows the chemical reactions of this fluid to be determined. The puncture is usually performed at the fourth lumbar interspace, and before any fluid is removed the intraspinal pressure is estimated by means of Ayer's water manometer which normally registers between 12 and 15 cm. As soon as the pressure has been estimated, Queckenstedt's test is made, which consists of reading and studying the rate of rise of the cerebrospinal fluid in the manometer following compression of both internal jugular veins. Sudden rise and rapid fall of the fluid on compression of both internal jugular veins, in-

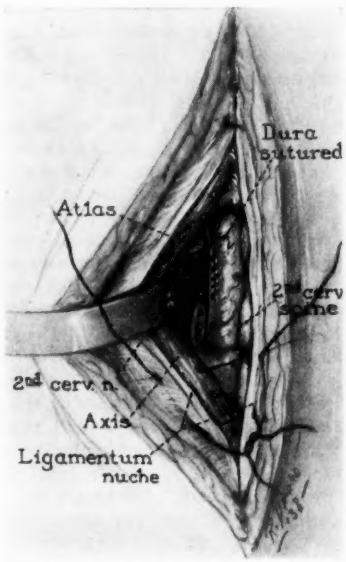

Fig. 5. Closure of dura and musculocutaneous wound.

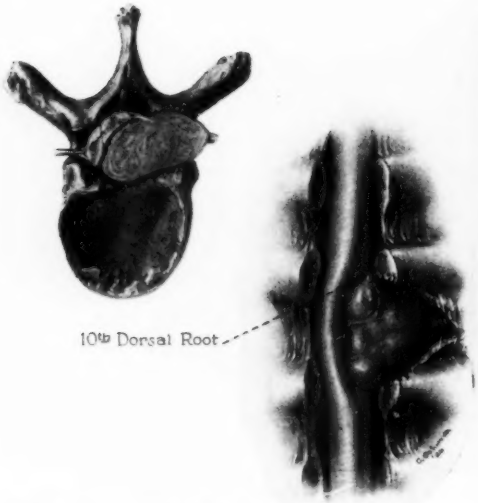

Fig. 6. Compression of the cord by a neurofibroma, with erosion of the vertebra and ribs.

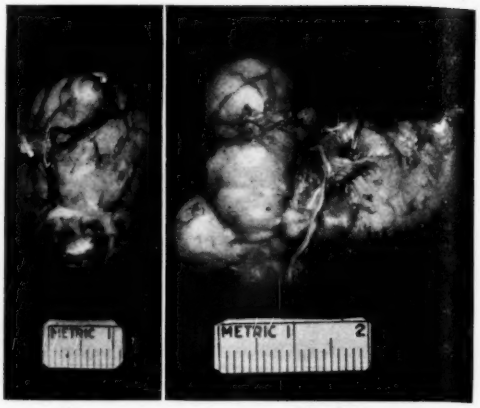

Fig. 7. Fig. 8.

Fig. 7. A neurofibroma which had undergone cystic degeneration.

Fig. 8. A cervicocranial dumb-bell neurofibroma.

dicate free flow of the cerebrospinal fluid within the subarachnoid space. Slow rise and fall of the fluid, or its failure to rise on compression of the jugular veins, suggest partial or complete intraspinal block.

Elsberg and Hare have suggested a modification of the test for subarachnoid block in cases in which tumor of the spinal cord is suspected. When the spinal puncture needle and manometer are in place, they suggest inhalation of amyl nitrite, instead of compression of the jugular veins, to create increased intracranial pressure. They stated that the rise in the manometer gives more information than the usual Queckenstedt test. Elsberg wrote that in 13 of 63 cases in which tumors of the spinal cord were suspected and in which this test was applied, subarachnoid block was demonstrated. This test is believed to be much more delicate than the usual manometric tests for subarachnoid block.

Inability to obtain fluid at the fourth lumbar interspace may signify that the tip of the needle has failed to enter the subarachnoid space, that fluid is absent, or that there is a tumor at this level. Puncture should be made at another level, and it may be necessary to make multiple punctures. Occasionally, it is necessary to combine cisternal puncture with lumbar puncture.

Spinal block (6, 38), if it results from tumor, frequently causes an increase in the concentration of globulin in the cerebrospinal fluid below the tumor. The fluid may also be xanthochromic (14) (Froin's syndrome) (21). The shade of yellow may vary, and occasionally the fluid above a block is decidedly yellow. The cell count is usually normal, but pleocytosis may occur if the tumor is situated in the spinal canal below the conus medullaris, and this may help in the distinction between tumors and inflammatory lesions.

The presence of partial or total block is not pathognomonic of intraspinal tumor, since previous attacks of meningitis, acute myelitis, injuries to the vertebræ, or spinal deformities are all capable of interfering with the free flow of the cerebrospinal fluid. However, it is apparent that the finding of partial or total block is extremely valuable in diagnosis when the block is accompanied by a history of root-pain, with a negative history of inflammation or trauma of the spinal cord.

Roentgenographic examination. Roentgenograms (22) should be made of anteroposterior and lateral aspects of the vertebral column (7, 8). These should be supplemented by stereoscopic and oblique views, localized at the level where, on clinical grounds, the tumor has been suspected to be. According to Camp and me (8), evidence of erosion of the vertebral pedicles, laminæ, and lateral and spinous processes caused by pressure usually is discernible before erosion is evident in the body of the vertebræ. In general, roentgenological evidence of changes resulting from tumors of the spinal cord consists of shadows indicative of erosion secondary to direct pressure, invasion

Fig. 9.

Fig. 10.

Fig. 11.

Fig. 9. Incision of skin and fascia exposing the spinous processes as the first step of laminectomy.

Fig. 10. Control of hemostasis by subperiosteal elevation of the erector spinæ muscles.

Fig. 11. The extent of the laminectomy in order properly to expose the subdural but extramedullary meningioma.

by the tumor, destruction caused by benign or malignant tumor of the bone, metastatic disease, and hyperostosis. Camp, in a review of cases in which operation was performed between January 1, 1931, and September 1, 1933, reported that osseous changes which directly localized the lesion were observed roentgenographically in 50 per cent of the cases. The percentage of cases in which osseous changes were detected varied considerably with the different types of tumors (neurofibromas, 65 per cent; endotheliomas, 11 per cent; ependymal-cell gliomas or caudal tumors, 66 per cent; hemangiomas and hemangio-endotheliomas, 33 per cent; intramedullary tumors exclusive of ependymal-cell gliomas, none).

"Camp divided tumors of the spinal cord into three groups, considered roentgenologically. The first, and fortunately the predominating group, were benign tumors arising from soft tissues within the spinal canal. The most common tumors of this group included neurofibromas, endotheliomas (meningiomas), hemangiomas, angiomas, lipomas, and dermoid cysts. Ependymal cell gliomas (ependymomas) were included in this first group because roentgenologically they resemble benign tumors. Among the common tumors named there are no individual distinguishing roentgenologic characteristics, except those possessed by the neurofibromas, which have a tendency to extrude through an intervertebral foramen, producing a dumb-bell or hour-glass tumor, partly within and partly without the spinal canal. Bony changes rarely occur in the absence of partial or complete block of the spinal canal, unless the tumor is held in contact with the bone by nerve roots or meningeal attachments. One pedicle of the vertebra at the level of the tumor usually exhibits, or both pedicles may exhibit, evidence of erosion before it can be discerned in the lamina or body. The pedicle is first flattened and, as the tumor grows, the surface becomes concave and eventually destroyed.

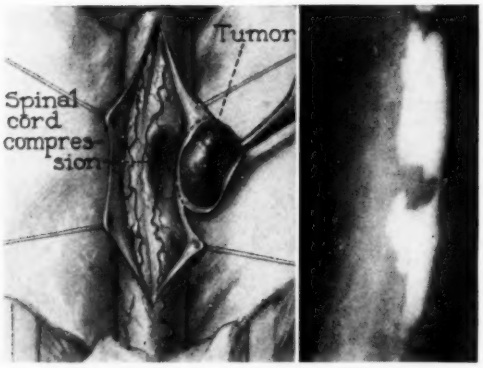

Fig. 12. Fig. 13.

Fig. 12. Removal of meningioma with attached meninges.
Fig. 13. Lipiodol study, localizing the tumor illustrated in Figure 12.

"The second group of tumors classified roentgenologically consists of malignant tumors arising from soft tissues within the spinal canal. Tumors of this group include both primary and metastatic lesions. The intramedullary tumors, particularly the gliomas with the exception of ependymal cell gliomas, which were considered in the preceding group, do not commonly involve the vertebræ secondarily. Sarcomas, lymphosarcomas, malignant hemangio-endotheliomas, and metastatic growths destroy the surrounding vertebræ by direct infiltration and thereby produce a well-recognized roentgenologic picture of malignant disease in bone. Extension into the paravertebral tissues is not uncommon. Rarely, from the secondary changes in the bone, can the primary or metastatic nature of the tumors of soft tissues be predicted, except as similar changes may be observed in other regions of the spinal column."

A third group of growths, according to Camp's (17) classification, arise from the intervertebral discs and involve the spinal canal; these are tumor-like protrusions.

Growths in this group are most common in the lumbar portion of the spinal column and consist usually of two types. One of the types includes chondromas, fibrochondromas, and fibromyxochondromas; the other type includes traumatic prolapse of intervertebral discs into the spinal canal. Because of their cartilaginous nature, these masses themselves are not visible in roentgenograms. However, the posterior portion of the intervertebral space may be narrowed and the contiguous bone may be eroded.

"*The benign tumors of the vertebræ* include osteomas, osteochondromas, chondromas, fibrochondromas, giant cell tumors, and hemangiomas. All of these tumors, which may involve the spinal cord by compression, have the same roentgenologic effects on the vertebræ as they have on other portions of the skeleton. Giant cell tumors usually involve the bodies of the vertebræ, although the bony processes are not uncommonly affected. This multilocular cystic lesion, primarily in the vertebræ, should be readily distinguished from localized erosion caused by a benign tumor of the spinal cord. Collapse of a vertebra produced irregular absorption and thickening of the trabeculæ of the bone, giving its structure a coarse, honeycombed appearance.

"*The tumors of the vertebræ* that are malignant and that secondarily involve the spinal cord, consist of sarcomas, myelomas, endotheliomas, metastatic carcinomas, and hypernephromas. The chordomas are included in this group, since they arise from remnants of the notochord that remain in the vertebræ or sacrum, and for roentgenologic consideration are essentially tumors of bone. They most commonly arise in segments of the sacrum, where they produce extensive malignant destruction and even invade the ilium and pelvic cavity. They are closely imitated by metastatic and malignant growths, and commonly are confounded with large lumbosacral ependymal-cell gliomas. However, ependymal-cell gliomas should be readily distinguished from malignant tumors of the vertebræ, because the secondary destruction of bone which accompanies the former is different from the primary destruction which accompanies the latter.

"Primary infectious conditions of the vertebræ, such as tuberculosis, osteomyelitis, actinomycosis, and coccidioidal granuloma may result in an intraspinal abscess, and the destroyed portions of the vertebræ, together with involvement of one intervertebral disc, or more than one, should suggest the presence of an infectious process, since the structures named are partially resistant to the invasion by tumor.

"*Study with radiopaque oil.* In addition to the roentgenologic evidence of tumors which is apparent in routine examination of the spinal column, fluoroscopic and roentgenographic study by the use of *radiopaque oil* has furnished much additional information in diagnosis and localization of intraspinal tumors. Injection of 5 c.c. of iodized oil into the subarachnoid space, either through cisternal puncture or lumbar puncture, allows visualization under the fluoroscope of the patency, or of the lack of patency, of the sub-

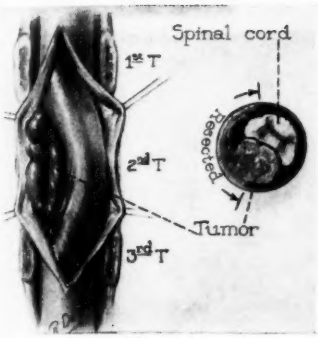

Fig. 14.

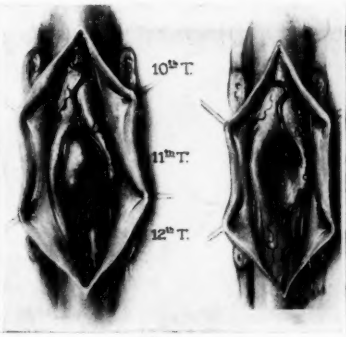

Fig. 15.

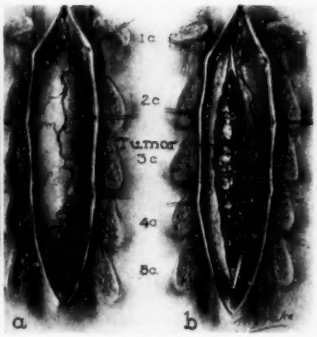

Fig. 16.

Fig. 14. The sessile character of an occasional meningioma.

Fig. 15. The degree of compression of the spinal cord that can result from a meningioma.

Fig. 16. *a* and *b*, An intramedullary spinal-cord tumor which presents a fusiform thickening of the cord with partial extrusion of the tumor when the cord has been incised.

arachnoid space. Fluoroscopic examination of the slowly moving oil is superior to examination of a roentgenogram, since the roentgenologist often sees the diversion of the current of oil around the tumor. However, roentgenograms should be made for confirmation of the levels where tumors are suspected to be. Intramedullary tumors are identified by division of the oil into two currents, one on each side of the cord. Use of the heavier oils avoids its ascent into the cisterns and ventricles. Because introduction of these oils invariably produces irritation of the meninges, and occasionally radiculitis, they should be used only to localize tumors definitely. After the oil has been injected, the patient should be placed prone on the fluoroscopic table, and the flow of oil should be observed when he is in various positions, from horizontal to perpendicular. Experience with the use of radiopaque oil in the diagnosis of tumor of the spinal cord has indicated that oil should be used infrequently, only when tumors are suspected, and that the oil should be removed at operation whenever possible. The presence of extramedullary tumors usually is indicated by definite arrest of the flow of lipiodol. If there is no tumor or compression of the cord, the oil descends and remains permanently in the sacral cul-de-sac."

Differential diagnosis. The symptoms of metastatic lesions may be the same as those of any benign tumor of the spinal cord, except that the progress of malignant growth is usually more rapid. Metastatic growths from carcinomas of the breast or prostate gland are most frequent. It must not be forgotten that a primary carcinoma of the breast may have been removed many years before metastasis gives evidence of its presence. Since carcinoma of the prostate gland may not produce local symptoms, rectal examination should be made as a routine procedure.

Among the various diseases that may be difficult to distinguish from tumor is hypertrophic pachymeningitis. In this disease, the dura becomes thickened, usually in the cervical region. This thickening pinches off the nerve roots, and causes pain, atrophy, and sensory disturbances of the arms and hands; by compressing the cord it causes impairment of function below the lesion.

The condition, meningomyelitis, may remain localized. There is often a history of antecedent trauma or infection. As a rule, examination does not disclose a Brown-Séquard syndrome; the upper level of anesthesia is usually indistinct, and all qualities of sensation are equally affected, possibly because the inflammation penetrates the cord.

The spinal column itself may be the seat of the original disturbance. Compression of the cord is not uncommon in Pott's disease. A somewhat infrequent cause of compression is chronic hypertrophic osteo-arthritis of the spinal column, of which the roentgenogram often fails to give evidence. Spondylolisthesis, or a slipping forward, usually of the fifth lumbar vertebra on the sacrum, often results in injury to the cauda equina. Occasionally, a case of Paget's disease is encountered in which the cord shows evidence of compression. A tumor may be superimposed on spina bifida. The difficulty lies in the fact that the symptoms of spina bifida occulta may be late in appearing, presumably on account of traction on the cord and nerve roots which are anchored

Fig. 17.

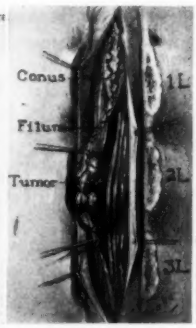

Fig. 18.

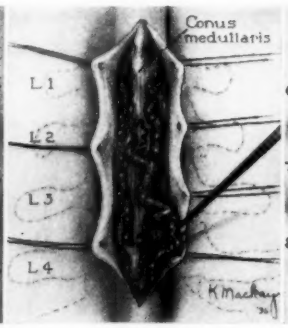

Fig. 19.

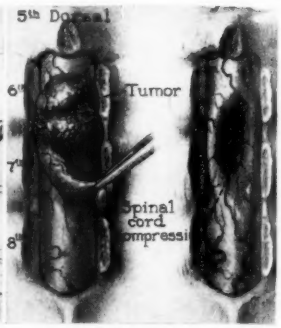

Fig. 20.

Fig. 17. Partial removal of an intramedullary spinal-cord lipoma which resulted in amelioration of symptoms and permitted the patient to return to his occupation of clothing clerk for seven years.

Fig. 18. A circumscribed ependymoma arising from the filum terminale.

Fig. 19. An arteriovenous fistula of the vessels supplying the conus medullaris and the cauda equina.

Fig. 20. The appearance of an extradural hemangio-endothelioma and the compression of the cord that it had produced.

below. Spindle-legs, deformity of the feet, an area of sacral hypertrichosis, and a sacral dimple are useful signs.

In cases of subacute combined degeneration of the spinal cord, the lesion, although progressive, is usually painless and diffuse.

The diagnosis of tabes dorsalis is sometimes erroneously made when the real cause of the symptoms is a tumor of the spinal cord or cauda equina.

It may be difficult to distinguish syringomyelia from intramedullary tumor (25). However, in the presence of the former the following usually aid in establishing the correct diagnosis: the characteristic waistcoat type of sensory disturbance, with a predilection for involvement of pain and temperature fibers since these lie near the central canal, and the local atrophy caused by extension of the process here and there into the anterior horns. If a tumor of the cord is associated with syringomyelia, the diagnostic difficulties may be insurmountable.

Although multiple sclerosis may produce a transverse lesion of the cord, the youth of the patient, the absence of pain, and the presence of cerebral signs, such as tremor, scanning speech, nystagmus, optic atrophy, ocular palsy, and the characteristic emotional lability, usually put the diagnostician on guard.

Operative technique. The operative technique (15, 20, 36) has become fairly well standardized and consists of laminectomy, which includes the removal of three or four spinous processes and laminæ in order to facilitate the removal of the tumor; it permits the surgeon to approach the tumor from above or below. A special type of anesthetic is not required; the induction of ether through an intratracheal Magill tube perhaps is most serviceable. A paravertebral regional anesthetic with pre-operative use of morphine and scopolamine decreases the amount of bleeding but cannot be used satisfactorily for hypersensitive or nervous patients. Nitrous oxide and ethylene are unsatisfactory since they both increase the venous bleeding during operation. Tribromethyl alcohol by rectal administration is a popular anesthetic at present and has the advantage of not aggravating chronic pulmonary lesions, but there is a disadvantage in the occasional idiosyncrasy to the drug.

In outlining the field for operation the surgeon must bear in mind the neurological segment involved and the fact that it is placed at a higher level than the vertebra itself. On exposure of the dura, cerebrospinal pulsations indicate that the exposure is above the tumor, whereas the absence of cerebrospinal pulsations indicates that the exposure is below the tumor.

The bleeding should always be controlled and this is most effectively done by subperiosteal elevation of the periosteum of the spinous processes and the laminæ in conjunction with the "erector spinæ" muscles rather than by incision of the muscle attachment lateral to the spinous processes. In removing the laminæ it is well to carry the resection wide to each side to prevent subsequent compressions of the cord by calluses that may develop. Prominent spinous processes above or below the laminectomy should be resected in order to prevent any undue promi-

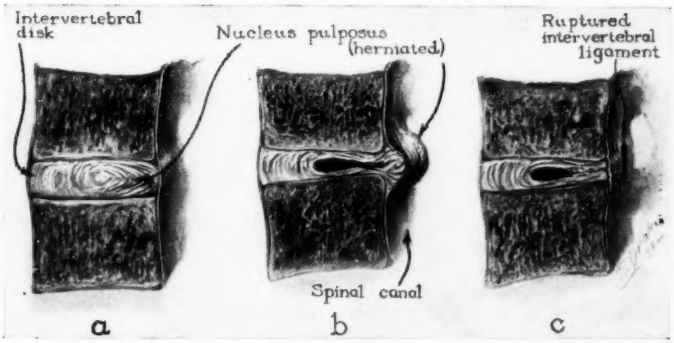

Fig. 21. The mechanics involved in the rupture of the intervertebral disc with prolapse of the nucleus pulposus. *a*, A normal intervertebral disc; *b*, prolapse of the nucleus pulposus into the spinal canal. *c*, appearance of the ruptured intervertebral disc following removal of the prolapsed nucleus pulposus.

nences in the wound, which invariably become tender if exposed to pressure. Unilateral laminectomy has some advantages in the cervical vertebræ in the prevention of slipping of one vertebra on the other.

In removing the laminæ over a tumor, one should always be careful to avoid additional pressure on the cord and always avoid accidental trauma or interference with the circulation by sponging the dissection. If the tumor is situated anterolaterally or anteriorly it is much wiser to split it and remove it piecemeal rather than to force it out at the risk of injuring the cord. Intramedullary tumors, such as hemangio-endotheliomas, ependymomas, and astrocytomas, may be partially or totally removed through a ongitudinal incision of the cord. Caution again is advocated to prevent additional trauma or interference with the circulation during dissection. In closing the wound it is well to suture the dura, except in intramedullary lesions when further growths of irremovable tumors are expected. Defects in the dura can be protected by animal membrane to prevent the entrance of blood into the subarachnoid or subdural spaces. The muscles are closed by interrupted sutures, as are the fascial planes, the subdermal, and skin layers. Drainage is rarely necessary, but if it becomes necessary gauze packs may be employed, but they should be so placed as to prevent pressure on the cord and should be removed in forty-eight hours to prevent cerebrospinal fistulas (Figs. 2 to 24, inserted as a block of illustrations to illustrate groups in sequence).

Postoperative care. Following the operation the patient is placed in bed in the lateral position on

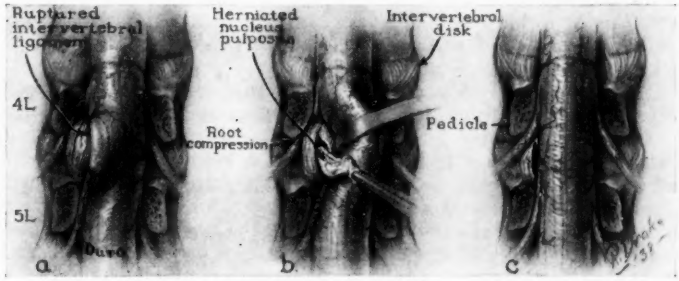

Fig. 22. The compression of the nerve root by the protrusion of the nucleus pulposus into the spinal canal and the relief of compression when the mass has been removed. *a*, Protrusion of the nucleus pulposus through a rent in the intervertebral ligament, compressing the lumbar nerve root; *b*, removal of the ribbon fibrocartilaginous nucleus pulposus; *c*, relief of compression of the nerve and dura following removal of the fibrocartilaginous mass.

Fig. 23.

Fig. 24.

Fig. 23. A typical specimen of a prolapsed nucleus pulposus removed at operation.

Fig. 24. A lipiodol study revealing two intraspinal protrusions of the nucleus pulposus.

pillows to prevent undue pressure on the tips of the shoulders and hips. It is preferable to turn the patient from side to side and on the abdomen rather than to allow him to lie on his back, as sweating may result in maceration of the skin and contamination of the wound, and interfere with primary union. The patient otherwise is treated as is the average surgical patient. If urinary incontinence is present it is safer, and the danger of cystitis is decreased, if an indwelling catheter rather than repeated daily catheterization is used. This catheter should be changed every four or five days and the bladder should be irrigated twice daily with an antiseptic solution. A urinary antiseptic in the form of sodium-acid phosphate and methenamine is administered as a precaution against ascending pyelonephritis. Usually daily doses of mineral oil with milk of magnesia are administered to prevent distention from fecal impaction. In addition, a daily enema is necessary. The patient is usually kept in bed for two weeks, when he is permitted to sit in the upright position in bed, and, subsequently, allowed to be taken about in a wheel chair and to walk if possible. The usual postoperative course continues for three weeks. Physiotherapy is advised if muscular cramps and motor weakness exist. Indwelling catheters should be permanently removed when the patient has recovered sufficient control of the bladder to enable him to empty it thoroughly.

Contractures and defense reflex spasms are corrected and relieved during the period of convalescence by the application of Buck's extension to the feet and legs in the reclining position. The recovery of motor, sensory, vesical, rectal, and sexual functions takes place in the reverse order of their previous disappearance.

SUMMARY

The surgical mortality for this group is 4 per cent. The time for recovery of motor and sensory losses depends on the character of the tumor and the degree and duration of the paralysis. Primary malignant and metastatic growths of the spine are rarely operable and therefore are not included in the study of intraspinal tumors. Hard, rounded tumors cause greater injury to the cord and more paralysis than the soft, elongated tumors. A 25-per-cent loss of function is usually recovered within three months, a 50-per-cent loss requires from six to twelve months, a 75-per-cent loss requires up to eighteen months, and a total loss requires up to two years unless the injury to the cord has been so extensive that recovery will never take place. The removal of intramedullary, infiltrating tumors often results in temporary improvement which may continue from six months to seven years, but rarely is recovery to any degree comparable to that following removal of extradural and subdural but extramedullary tumors.

It is apparent that the approach to completeness of recovery depends directly on the duration and extent of injury produced by the neoplasm, so long as the blood supply to the cord has not been destroyed by the tumor. Recovery can be anticipated even in cases of extensive paralysis, since compression produced by the tumor results first in destruction of the gray substance of the cord, second in compression atrophy of the myelin, and lastly in destruction of the axons. However, if at any time the dorsal or ventral arteries become compressed or thrombosed, the damage from the resulting paralysis remains permanent. This undoubtedly explains the difference in the degree of recovery following partial or complete paralysis attributable to intraspinal tumor and to injuries, for in the former instance the circulation of the cord is usually maintained, whereas in the latter instance the circulation is found to be destroyed.

Eighty-five per cent of intraspinal tumors are benign and are operable. The differential tests make it possible to operate earlier on the patient and to obtain more rapid and more nearly complete results.

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SURGERY OF THE NERVOUS SYSTEM

BRAIN AND ITS COVERINGS; CRANIAL NERVES

Jupe, M. H.: The Reaction of the Bones of the Skull to Intracranial Lesions. *Brit. J. Radiol.*, 1938, 11: 146.

When bone lesions are viewed by means of roentgen rays, the bone shows pathological change in one of two ways: there may be an excess of new bone being laid down, as in predominating osteoblastic activity; or the absorption rate may exceed that of apposition, as in predominating osteoclastic activity. When an intracranial lesion is present, it has been found that the bones of the skull may show either of these types of activity with either a general or local reaction.

Jupe states, "General reaction is secondary to a rise of intracranial pressure and can be explained almost entirely by pressure atrophy." Convolutional marking, so common in the child, must be viewed with suspicion in the adult. Thinning of the inner table, changes in the vascular channels, and increase in the size of the foramina for the emissary veins are other reliable signs of increased intracranial pressure. The sella turcica may show changes, either posterior or anterior at the clinoids, or there may be pressure changes in the floor, but the author warns of the pitfalls in interpreting too closely the changes which the x-rays may reveal in the sella. According to him, it is a notoriously deceptive place of change; he believes that change in the sella means primarily, not an intrasellar lesion, but simply an intracranial lesion. Ballooning of the sella may occur even when the lesion is not actually in the sella, but follows, possibly, a remotely placed tumor (Fig. 1). The author discredits Kopylov's theory that inspection of the dorsum sellæ will indicate whether the lesion is supratentorial or infratentorial. He makes the interesting observation that the dorsum may regenerate following the removal of the cause of the increased pressure, provided that the dura and the periosteum which cover it have remained intact and unchanged by the pressure (Fig. 2).

Local reaction in the skull bones, due to an underlying tumor, is a simpler, more easily understood process. The changes are easily recognized and well known to roentgenologists and neurological surgeons alike; they are: (1) thinning of the bone over an old, slow-growing astrocytoma; (2) bulging and thinning over a tumor in a child (Fig. 3), and (3) an increase in density and vascularity of the bone and, frequently, hyperostoses and spicule formation at the site of a meningioma. In differentiating osteoma of the skull, the author points out that cancellous osteoma usually arises in young people, that the new bone is laid down parallel to the surface of the skull and not at right angles as may be the case in hyperostoses, that the original outline of the bone is lost, which is not true in the hyperostosis of meningioma, and that osteoma of the skull should not alter the intracranial pressure or the protein content of the cerebrospinal fluid. JOHN MARTIN, M.D.

Peers, J. H.: Spheno-Occipital Chordoma. *Am. J. Cancer*, 1938, 32: 221.

In this brief account Peers has reported the case of a spheno-occipital chordoma in a woman of thirty-five years, the tumor having arisen from the region of the clivis without encroachment upon the sella

Fig. 1.

Fig. 2.

Fig. 3.

Fig. 1. Large calcified oligodendroglioma of frontal lobe, causing enlargement of pituitary fossa with thinning of dorsum sellæ, and increased convolutional markings.

Fig. 2. Three years after removal of a cerebellar tumor, showing the dorsum sellæ returned to normal. Fig. 3. Thinning and bulging in temporal region, due to an astrocytoma in a young boy. The ventricular system is displaced to the contralateral side.

turcica, and invaded the brain stem at the junction on the peduncles and pons. This type of tumor, arising as it does from notochordal remnants, has been reported only 71 times previously. The tumor was composed mainly of "cords, masses, and concentric nests of cells embedded in a fairly abundant homogeneous or stringy mucoid matrix." No mitoses were found. Characteristic of this tumor were many fine cellular fibrils which stained like fibroglia, their presence being shown most advantageously by a phosphotungstic acid hematoxylin. This feature has been described only once before, probably because formalin fixation and hematoxylin-eosin stain, most commonly used, will not demonstrate the presence of such fibrils.

JOHN MARTIN, M.D.

Riehle, R.: A Clinical Study of the So-Called Delayed Paralysis of the Facial Nerve (Zur Klinik der sogenannten verspaeteten Facialislaehmung). Freiburg: Dissertation, 1937.

The facial nerve, because of its anatomical course, is particularly endangered in cases of fracture involving the base of the skull; however, in fully half the cases the paralysis is late in appearing. In a collective study of the period from 1929 to 1935 there were 393 skull fractures in men. Ninety-six were basal and 15 presented paralysis of the facial nerve. The paralysis occurred immediately after the fracture in 7, and after a few days in 8. Of 69 skull fractures in women, 15 involved the base and there was only 1 case with delayed facial paralysis. In immediately fatal craniobasal fractures, paralysis of the facial nerve is frequently present, without, however, receiving further notice. Roentgenologically, basal fracture was found in only 10 of the 15 cases of facial paralysis; therefore the symptom was present in 10 per cent of all of the 96 cases of fracture of the base of the skull.

From an extensive compilation from the literature, it was observed that involvement of the facial nerve is on the whole higher than 10 per cent, up to as high as 32 per cent; delayed cases are recorded only occasionally, usually after from four to seven days. The author gives detailed data on his own 7 cases.

The site of the fracture or of the pressure can be located with fair accuracy by means of Bing's schema, frequently better, in fact, than from the roentgenogram. Return of the response to electric stimulation keeps pace with the recovery from the paralytic symptoms; while the sense of taste and the secretion of tears return to normal sooner than the paralysis. Stretching, injury, pressure from hemorrhage, and swelling in the narrow facial canal bring on facial paralysis immediately or after a delay, and later permit its disappearance, but when the nerve has been torn the paralysis is permanent. In all of the cases of delayed facial paralysis in Freiburg i. Br. the course was very good; treatment was given with the galvanic, faradic, or intermittent current. (EGGERT). JOHN W. BRENNAN, M.D.

SPINAL CORD AND ITS COVERINGS

Loman, J.: Human Craniovertebral Dynamics. *Am. J. Surg.*, 1938, 39: 479.

Under many different adverse conditions the cerebral circulation is able to maintain a remarkable resiliency and the ability to keep intracranial pressure at a more or less constant level. Although the skull itself is a rigid box, its contents are in no sense submitted to the inconveniences of such a container, for the foramen magnum, the craniovertebral system of veins, the cerebrospinal-fluid flow, the many other veins flowing from the intracranial contents, and the adaptability of the arterial bed all act concertedly to allow the wide fluctuations in intracranial pressure which necessity may require.

The activity of the cerebrospinal fluid is dependent upon a stable production and absorption mechanism and the adaptability of the intracraniospinal veins to pressure shifts. Physiological variations in the pressure of the cerebrospinal fluid depend upon the venous pressure, with which the cerebrospinal-fluid pressure varies directly, and upon changes in the caliber of the cerebral vessels. A third factor, that of changes of osmotic pressure, seldom affects the normal cerebrospinal-fluid pressure, though in certain pathological states which require hypertonic sucrose, this may be of the greatest importance.

Loman points out that since the pressure of the cerebrospinal fluid is a direct index of the venous pressure upon which it is dependent, great and sudden alteration in the arterial pressure must occur before the arterial side of the tree affects the cerebrospinal-fluid pressure, and therefore changes in the pressure of the latter will not alter the arterial pressure. In his experience the drainage of large amounts of cerebrospinal fluid has no effect on the carotid pressure and therefore probably not on the cerebral arterial pressure. He believes that therapeutic lumbar puncture in cases of craniocerebral injury is not attended by the danger of bleeding or increasing intracranial bleeding. He believes that such a reduction as, for instance, 50 mm. of water pressure in the cerebrospinal fluid can have little effect on an artery carrying a pressure of from 1,000 to 1,500 mm. of water.

The discussion of the effects of drugs and anesthetics on intracranial pressure is a practical and informative one. The article contains an excellent bibliography. JOHN MARTIN, M.D.

PERIPHERAL NERVES

Gatta, R.: Laterotermínal Anastomosis of Peripheral Nerves (Sulla anastomosi latero-terminale dei tronchi nervosi). *Arch. ital. di chir.*, 1938, 48, 155.

A motor nucleus can extend its innervation to fields outside of its original destination, as in the case when the facial and hypoglossal nerves are anastomosed. Termi's experiences have shown that spinal cord nuclei easily adapt themselves to inner-

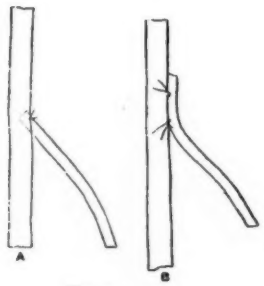

Fig. 1.

vate new territories, and that this extra-territorial innervation is accompanied by a hypertrophy of the ganglion cells. It is also quite well established that regeneration of nerves is accompanied by a numerical increase of the regenerated fibers. Gujon has estimated that this increase is from one-fifth to one-third of the original number of fibers.

The author performed three series of experiments on rabbits:

In the first the proximal end of the severed peroneal nerve was imbedded in the side of the tibial nerve (Fig. 1a) and secured by one fine silk suture.

In the second a superficial longitudinal incision piercing only the perineurium was made on the tibial nerve; the proximal end of the peroneal nerve was scarified for 3 or 4 mm. and anastomosed to the tibial by two fine silk sutures (Fig. 1b). Severing of the fibers of the tibial nerve was unnecessary as the simple application of the sutures accomplished this, as shown by Ballance and Bailey.

In the third series of experiments the latero-lateral anastomosis was used, but it was performed a month after the peroneal nerves had been cut instead of immediately as in the first two groups.

In the three groups, the microscopical examination of the nerves showed that on the twentieth day postoperative regeneration into the peroneal nerve was well started, and that by the forty-fifth day the process was in its final stages. Function of the peroneal nerve was restored, although with the time limits of the experiments some atrophy of the muscles was still present. The interim between the original section of the peroneal nerve and its anastomosis to the tibial had apparently no effect on the rate of regeneration. Of the two methods of anastomosis the author prefers the laterolateral type as it gives slightly more satisfactory results than the laterotermINAL anastomosis.

DAVID IMPASTATO, M.D.

SURGERY OF THE THORAX

TRACHEA, LUNGS, AND PLEURA

Glass, G.: A Case of Tuberculoma of the Trachea. *J. Laryngol. & Otol.*, 1938, 53: 188.

The author reports in some detail a case of tuberculoma of the trachea in a male seventy-two years of age. X-ray examination revealed involvement of

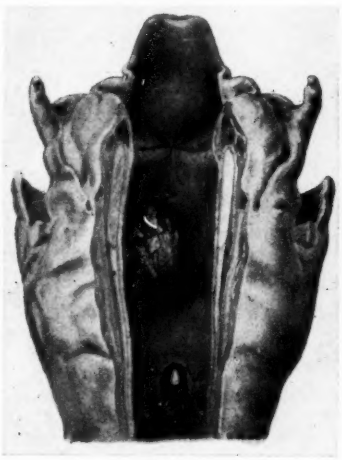

Fig. 1.

the lungs and a mass in the trachea. Autopsy revealed a pedunculated tumor arising by a fine pedicle from the left side of the trachea about two centimeters below the vocal cords.

JAMES C. BRASWELL, M.D.

Tiegel, M.: Concerning Valvular Drainage in Injuries of the Thorax, Particularly in Chest Gunshot Wounds (Ueber Ventildrai nage bei Thoraxverletzungen, insbesondere bei Brustschuessen). *Zentralbl. f. Chir.*, 1937, p. 2775.

Valvular drainage which completely excludes the air is extremely serviceable: (1) in pneumothorax under tension, following the tearing of lung tissue due to a dull force, a cut, stab, or gunshot; (2) in the presence of exudate with symptoms of compression; and (3) in cases of open pneumothorax. Tiegel, as early as 1912, had already called attention to this type of drainage, and had described a valve-like plate which permitted the exit of air, blood, and exudate from the chest cavity, and at the same time prevented the sucking in of air, however, by means of a thin rubber plate. He regrets the fact that this apparatus was not used during the World War. He has improved it and uses it together with a valve-bearing trocar, constructed in a similar manner.

He then presents a discussion of the various types of chest injuries which occurred during the World War. The mortality of open wounds amounted to 90 per cent at the beginning of the War, and then, as the result of the improved surgical measures and high pressure apparatus, it went down to 32.2 per cent (according to the combined statistics of Jehns). The immediate closure of an open pneumothorax was soon recognized as a vital procedure. However, according to the statistics of Laewen, in addition to the 20 per cent mortality which occurred after operation, another 20 per cent occurred later due to empyema and tension pneumothorax; 14 of the latter 20 per cent was due to tension pneumothorax. The ideal procedure, therefore, is the exact examination of the pleural cavity and the lung, the proper treatment of these wounds and, following this, a careful suturing of the skin. This procedure is possible only during the first twelve hours and in those cases in which the patient can remain at the same field station (Goetze). In cases which come for treatment later, in which there is serious contamination of the wounds, or in which it is impossible to operate, tamponade of the chest wound, as Sauerbruch has recommended, is indicated (Franz).

In the latter type of cases Tiegel recommends the employment of his valve drainage plate which is from 10 to 18 cm. in diameter, immediately closes the chest wall, and brings about the normal pressure relationships. This makes possible the expansion of the lung and on the other hand provides for the exudate drainage. In those instances in which exact surgical procedure can be instituted in the cases of open pneumothorax, the trocar valve plate should nevertheless be introduced into the line of suture at the level of the third rib posteriorly in the line of the scapula in order to provide for better drainage, and to prevent the development of hemothorax and tension pneumothorax. This latter piece of apparatus is constructed in a manner similar to the one referred to, only that it is of smaller dimension, from 7 to 14 cm., and has an accompanying stylet so that it becomes unnecessary to perform a thoracotomy. This trocar comes into question when the chest wall is closed, in those cases in which there is a small, simple wound of entrance and exit without open pneumothorax and without palpable splintering of the chest wall and precarious general condition, in which one should, according to Franz, operate only when the surgical requirements are completely filled and in which a high-pressure apparatus is available.

On the one hand the absence of these required conditions at the front lines, and the precarious general condition of the patient on the other hand, often do not permit the performance of a major operation, and in these instances it is possible to produce amelioration by means of this trocar and to provide an avenue of exit for collected blood or

possibly the escaped air. The author at the same time recalls his experimental work on dogs in the year 1913 in which he was able to show how great a tendency to good spontaneous healing there was even in the presence of large lung wounds, provided that a major arterial branch had not been injured, if drainage had been provided for by means of valve drainage.

The trocar may be used even in those cases which have hitherto been handled conservatively, because in most of these instances there are complications caused by a hemothorax which later necessitates frequent thoracentesis if the latter is not to become absorbed spontaneously. By means of this trocar the formation of scar tissue is avoided and the period of convalescence is shortened. Furthermore the author recommends the use of this apparatus in the after-treatment of empyema.

(Max Tiegel). Harry A. Salzmann, M.D.

Wangensteen, O. H., Carlson, H. A., and Bowers, W. F.: Partial Thoracoplasty for Pulmonary Tuberculosis; with a Suggested Plan of Operation, Including Preliminary Anterior Chondrocostectomy, Together with a Review of Results. *J. Thoracic Surg.*, 1938, 7: 365.

In the development of the modern type of thoracoplasty the tendency has been to make the procedure as selective as possible and to divide the operation into multiple stages. As another step in diminishing the severity of the operation and in making it more effective, Wangensteen in 1934 began performing an anterior chondrocostectomy as a preliminary stage to posterior thoracoplasty. A survey of the results obtained in 42 patients operated upon by this method in somewhat more than three years has convinced the authors of the value of the plan.

The anterior chondrocostectomy was performed under local or cyclopropane anesthesia. Through a single short transverse incision over the second rib the first three costal cartilages were resected together with short anterior segments of the corresponding ribs. The ribs were stripped posteriorly along their lower borders from the periosteum by means of an O'Brien periosteal stripper to facilitate their complete removal at the time of the posterior operation.

The first posterior operation was done through the usual approach and the previous partial separation of the ribs made their removal easier. Extrafascial apicolysis as described by Semb was added to the thoracoplasty whenever feasible and was accomplished in 10 patients.

At the second posterior operation segments from the fourth, fifth, and sixth ribs were usually resected. When six ribs were considered sufficient for adequate collapse the base of the scapula was frequently resected, as suggested by Holman, to prevent its catching the seventh rib. Further resection of the ribs was done as needed in later stages.

In discussing the postoperative care of the patients, in addition to the points upon which all are agreed the authors draw attention to the observation

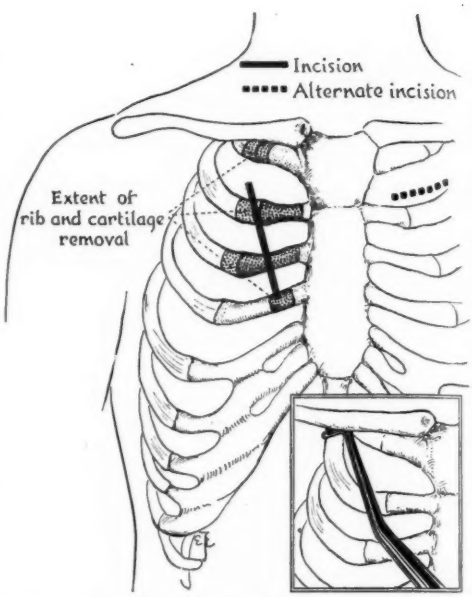

Fig. 1. Anterior chondrocostectomy. A suggested plan of operation for thoracoplasty (O.H.W.). The incisions employed are indicated together with the extent of rib and cartilage removal. The oblique incision permits better exposure, but the operation can readily be done through a single transverse incision over the second rib. The resulting scar remains less prominent. The insert shows how the second and third ribs are freed from their beds and the intercostal muscle bundles attached to their lower margins.

that gastric dilatation may at times cause dyspnea and tachycardia. This complication was noted mainly after the second or third posterior stage when done on the left side.

External axillary compression with synthetic rubber sponges was used consistently after the second posterior stage. This was started as soon as the wound was no longer tender and continued until osteogenesis produced a firm chest wall, usually from six to ten weeks after the last operation. No weakness of the anterior chest wall was noted in a single case following resection of the upper three costal cartilages.

Many patients developed an elevated shoulder on the side which was operated upon. This was thought to be caused by the long continuance of the lateral decubitus position after operation which caused the scapula to become fixed in a high position. Because of this experience the authors believe that the lateral position should not be long maintained unless necessary for adequate pulmonary collapse.

Among the 42 patients there were all varieties of lung involvement. Twenty of the series apparently had active bilateral disease. Pneumothorax had

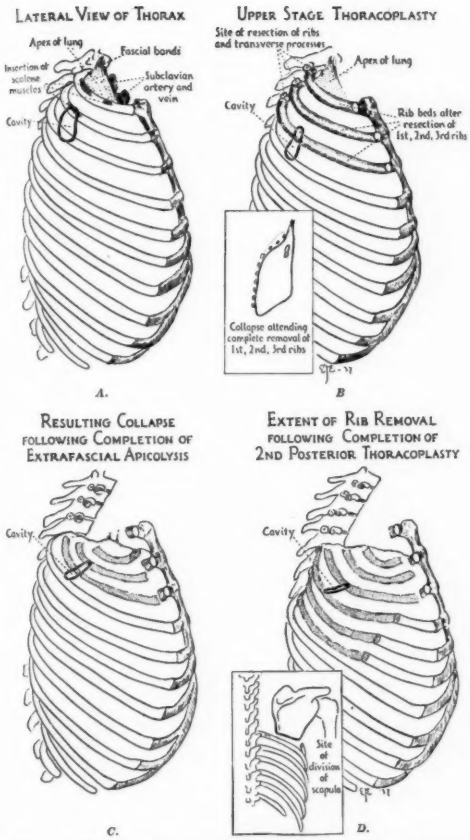

Fig. 2. Diagrammatic sketches of lateral view of thorax to show effects of thoracoplasty and apicolysis on the lung.

A, Before operation. Note attachment of fascial bands.

B, After upper-stage thoracoplasty there is collapse of the upper portion of the lung without descent of the apex.

C, After extrafascial apicolysis the apex has been immobilized and is now seen at a level of the fourth rib posteriorly. The collapse obtained in this manner approaches more closely to the ideal of concentric collapse and should permit more effectual closure of cavities.

D, After second posterior thoracoplasty. Resection of additional (two, three or four) ribs adds further to the collapse of the diseased portion of the lung.

been attempted at some time in practically all. Diaphragmatic paralysis had been induced in 24 of them, but during the last two years this had not been done immediately preceding thoracoplasty.

In comparing the reactions following the different stages it was found that the anterior chondrocostectomy gave rise to the least severe. It also seemed to provoke a scar-tissue reaction which aided in stabilizing the mediastinum.

The most serious complications were the result of aggravation of the pulmonary tuberculosis which caused it to spread to the contralateral lung or to progress in a previously existing lesion. The 2 postoperative deaths were due to such complications. The mortality for the series was 4.76 per cent and the operative mortality was 1.37 per cent for 146 procedures. This mortality rate was a marked improvement over that obtained in the series of 42 patients operated upon according to the Wilms-Sauerbruch technique: there were 6 hospital deaths and the mortality rate was 14.28 per cent.

A study of the authors' patients after from six months to three years shows that 50 per cent of them have closed cavities and negative sputum. This percentage also holds for the 10 cases in which apicolysis was added to the thoracoplasty. The authors conclude that although the Semb operation definitely augments the anatomical collapse, there was no evidence in this series that it improved the final results. RICHARD H. MEADE, JR.

HEART AND PERICARDIUM

Saloz, C., and Roux-Berger, J. L.: Precordial Thoracectomy, Brauer's Operation (Thoracectomie pré-cordiale, opération de Brauer). *Mém. l'Acad. de chir.*, Par., 1938, 64: 392.

Saloz and Roux-Berger report the case of a man forty-three years of age, who had had a severe attack of streptococcus septicemia with pleurisy and pericarditis. This had resulted in bilateral phrenocostal symphysis, as shown by radiological examination, and also in cardiac symphysis. There was cardiac insufficiency with edema, passive congestion of the liver and lungs, and a negative T-wave in the electrocardiogram; but there was no disturbance of the cardiac rhythm and no valvular disease. A precordial thoracectomy was done by Brauer's method with removal of the second, third, and fourth ribs. The patient showed definite improvement after operation. A year later, the edema had entirely disappeared and the size of the heart was diminished, as shown by the orthodiagram, but the T-wave still was negative in the electrocardiogram and the enlargement of the liver persisted. The patient was feeling well and able to work. Two years after operation the patient reported that he was in good health, but he died shortly after from a sudden gastric hemorrhage, due to a ruptured blood vessel, which was very probably related to the hepatic cirrhosis.

ALICE M. MEYERS.

THE PROBLEM OF DUODENAL ULCER

Collective Review

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THE literature concerning duodenal ulcer is so voluminous each year and so many of its aspects are controversial that a review and evaluation of the problem occasionally seems indicated.

Most writers now agree that the term "peptic ulcer" should be discarded and that in any discussion very careful distinction should be drawn between the terms "duodenal" and "gastric" ulcer. These two lesions are dissimilar biologically, physiologically, and pathologically. For example, Walton (71, 72) has stated that approximately 10 per cent of gastric ulcers become cancerous and that approximately 20 per cent of cancers of the stomach originate from gastric ulcers, whereas a primary duodenal ulcer rarely if ever undergoes malignant change. From the standpoint of treatment an essential difference also exists. In resection for gastric ulcer relative achlorhydria almost invariably follows the Polya and Billroth I procedures and recurrence practically never takes place. On the other hand, Klein, Aschner, and Crohn (35) have reported that relative achlorhydria results in from only 60 to 70 per cent of the cases following the Polya operation, and Walters and Wolff in approximately 25 per cent following the Billroth I resection for duodenal ulcer. Graham (27, 28) has said, "much harm, confusion, and disastrous therapy" come from considering these two conditions as a single entity.

Medical treatment has become established on a firmer basis and, with greater experience and better diagnostic tests, it has been possible to determine more accurately which patients will respond best to medical treatment. It is now generally recognized that from 50 to 75 per cent of all patients with duodenal ulcer will obtain satisfactory results from medical treatment. The surgical indications for the treatment of duodenal ulcer are also better appreciated and there is a definite tendency to suit the surgical procedure to the individual patient. The indications for partial gastrectomy for duodenal ulcer are also becoming clearer. There has likewise been much controversy concerning the subject of bleeding duodenal ulcer, but from these numerous, almost diametrically opposed opinions there has developed sounder judgment of the indications for, and the value of, the various types of treatment.

Gage and his associates (25) have pointed out that the most important factors in the causation and persistence of peptic ulcer are: (1) the inherent constitutional predisposition to form ulcer, that is, the ulcer diathesis; (2) the tissue susceptibility to ulcer, and (3) the increased gastric acidity. If this conception of the problem is correct, the clinician's therapeutic endeavors should be directed toward controlling gastric acidity because there is probably little that can be done to change the inherent predisposition and the susceptibility of the tissues. This attitude is definitely sound, and just as gastric acidity must be controlled to heal an ulcer, it must continue to be controlled to prevent recurrence after healing by any form of treatment, medical or surgical. That certain individuals, certain races, and even certain individuals from certain localities have a greater predisposition to peptic ulcer or a greater tissue susceptibility to ulceration is true beyond a doubt. It is unfortunate that we have no definite method of measuring this predisposition in tissue susceptibility. Such a method would be of inestimable value in determining the therapeutic procedure to be carried out in a given case. Without such a method one must depend on a careful clinical study and analysis of the case, considering the gastric-acid values and the roentgenological and gastroscopic reports.

MEDICAL TREATMENT

Many patients with uncomplicated duodenal ulcer fail to respond to medical treatment because of delay in the diagnosis and lack of efficient treatment over a proper period of time. As in the surgical, so in the medical, treatment of ulcer, care must be exercised in selecting cases for treatment. Eusterman (14, 15) believed that medical treatment was indicated when symptoms were of short duration, especially in the cases of younger

From the Division of Surgery, The Mayo Clinic, Rochester, Minn. Submitted for publication May 11, 1938.

individuals. Older patients with chronic but uncomplicated lesions whose symptoms are not progressive also do well on a medical regimen. Mild postoperative complaints certainly are best treated medically, and, naturally, medical management is the treatment of choice when serious complications are present. Hartman, in a recent lecture, stated that satisfactory results could be obtained from medical management in approximately 75 per cent of cases of duodenal ulcer. A salient argument for medical treatment was the large number of healed duodenal lesions found by Robertson (58) at autopsy in cases in which a diagnosis of ulcer had never been made. Of patients with duodenal ulcer seen at the Lahey Clinic (37, 39), only 8 per cent were operated on.

Treatment, however, tends to be of value only during its application, and when the indifferent patient leaves his physician's care he is likely to lapse into his usual mode of living with all the exciting causes which produced the original trouble. The modern trend of treatment for this disease emphasizes the need for acquainting the patient with the nature of his trouble and for explaining the rationale of treatment. Particularly are stressed the ill-effects of smoking, stimulating gastric secretion as it does and causing contraction of the blood vessels, and of alcohol and improper food; the need for leisure; and the avoidance of excitement. Ulcer is a condition as demanding of constant consideration as diabetes and essential hypertension.

Of the many forms of medical treatment Sippy's diet-alkali regimen together with the use of sedatives still ranks highest. It has been modified to avoid nutritional disturbances and the unbalance of the acid-base ratio. Eusterman (15) mentioned the use of whole-milk powder as a substitute for cream and milk mixtures. Powdered milk is more convenient and it produces an increased reduction in acidity and the elimination of half the feedings. In the treatment of the aged, and when the kidney and liver are damaged, tribasic phosphates may be employed to offset the danger of alkalosis. For the control of bleeding tendencies recent investigation has demonstrated the efficacy of an adequate intake of Vitamin C which orange juice can provide.

Observations by Rivers on the use of duodenal extract have been limited so far by his inability to obtain sufficient proper material, but they indicate that this extract may be useful in the physician's armamentarium as an adjunct to the usual measures. Parenteral administration of protein, histidine, and vaccines; continuous aluminum-hydroxide drip and mucin therapy, although useful in some instances, have not been generally accepted.

PREPARATION FOR SURGICAL TREATMENT

Of the various complications of duodenal ulcer, perforation and occasionally hemorrhage are the only two demanding immediate surgical interference. Unless due to perforation, pain is rarely so intractable that it cannot be controlled by nonoperative measures. Therefore, ample time is generally available for proper care of the patient before he is submitted to operation. Certain conditions may have reduced the patient's vitality to a subnormal level and this decidedly increases the surgical risk if measures are not taken to bring about an improvement. Such conditions may be loss of blood from hemorrhage, localized peritonitis, periduodenal abscess, and severe pyloric obstruction. In the last-named instance persistent vomiting may bring about a poor state of nutrition, the patient may become dehydrated, and there may be loss of certain normal constituents of the blood, such as protein, and the acid-base equilibrium may be upset. In addition, the stomach may be overdistended and toneless. Only a few days of continuous or repeated suction drainage permit the stomach to resume much of its tone and normal size. Body fluids may be restored and the nutrition improved with intravenous injections of glucose and saline solution. Protein, if the reduction is notable, may best be replaced by a blood transfusion. In certain rare cases of malnourishment, jejunostomy may be a judicious preliminary measure prior to gastro-enterostomy or resection.

Because of the ability of the acid contents of the stomach to sterilize, Marshall has recommended that alkali therapy be withheld two or three days before operation. For those who are run down and exhausted nervously by the rigors of their illness a few days of rest in bed, terminating a reasonable number of days prior to operation, make for a smooth convalescence. The preoperative preparation of the patient with anemia as the result of bleeding from a duodenal ulcer will be discussed in the section on hemorrhagic duodenal ulcer.

INDICATIONS FOR SURGICAL TREATMENT

The indications for surgical treatment are based on extensive clinical and experimental studies. Apart from certain fundamentals in selecting cases for operation, importance is attached to the need of careful appraisal of each individual patient with a view toward the selection of the proper procedures to produce the best results in

his particular case. In cases other than those of perforation, Balfour (5) has said that surgical treatment is indicated when the symptoms fail to be alleviated despite proper medical care. Lahey (37) took the same stand when pain persisted in spite of medical management. Thus to these authorities chronicity assumes prime importance in the selection of cases for operation. Balfour has also said that in certain cases the symptoms may be so intractable that operation is warranted even at an early stage. Another reason of essential importance, according to Lahey, is persistent and recurring pyloric obstruction leading to malnutrition and distressing symptoms. One indication for operation in chronic cases, according to Eusterman and Balfour (16), is that about a third of the patients have associated disease of the gall bladder or appendix, conditions which do not yield to medical treatment and which excite the ulcer. A history of subacute perforation is held by many to be an indication for operation. The failure of patients to follow the requirements of medical treatment after the ulcer seems healed and the resultant recurrence are held by some to be another reason for operation. Again, factors pertaining to the economic condition of the patient or his residence away from medical assistance assume importance as indications for surgical treatment. Finally, there is the question of the bleeding duodenal ulcer, concerning the treatment of which there is so much difference of opinion. This will be discussed in a later section.

Obstructing cicatricial duodenal ulcer with low acidity. When duodenal ulcer has produced obstruction at the outlet of the stomach by cicatrization or a marked degree of edema, gastro-enterostomy is generally the treatment of choice. The results of the operation tend to be excellent since, in addition to the circumvention of the obstruction, assistance is rendered to the impaired motor function of the stomach. Furthermore, the factors producing this dysfunction have also reduced the secretory activity of the stomach through atrophy of the gastric glands. Thus, if gastro-enterostomy is performed, the susceptible jejunal mucosa tends to be freed from the menace of gastric acids. A further advantage has been demonstrated by one of us (Walters, 68), who showed that posterior gastro-enterostomy produces a reduction of from 30 to 50 per cent in the gastric acidity by its neutralization and dilution by duodenal secretions. Graham (27, 28) and his colleagues have found posterior gastro-enterostomy or a Finney pyloroplasty most suitable in the case of such obstructive lesions, in their experience the Judd pyloroplasty and Wilkie type of gastroduodenostomy not having proved successful.

Duodenal ulcer without obstruction and with high acidity. That group of patients less than fifty years of age who have ulcer uncomplicated by obstruction but who have a high degree of free hydrochloric acid is estimated by Graham to present the most difficult problem in the surgical treatment of duodenal ulcer. He believes that the condition requires the most careful medical attention and the fullest co-operation on the part of the patient before operation is to be considered.

Graham offered his results of operative treatment for this group of patients. Eighty-nine patients were subjected to posterior gastro-enterostomy. Three deaths, or 3.3 per cent, resulted from a non-functioning stoma; anastomotic ulcers developed in 11 cases. Graham, in the light of his increased experience, attributed the latter complication, serious as it is, to the improper choice of surgical procedure in the face of high value for free hydrochloric acid. A series of 9 patients belonging to this group were treated by gastroduodenostomy; there was 1 death, and 1 anastomotic ulcer developed. Wilkie advised against the performance of gastroduodenostomy in such cases.

The fuller experience of Graham and his associates has led them to employ gastric resection in more and more cases of ulcer without obstruction in which the acidity was high. Their procedure removes the pylorus and most of the lesser curvature of the stomach, as advocated by Finsterer (20). The results of partial gastrectomy in this group were better than the results following gastro-enterostomy. In 131 cases there were but 3 deaths, or a mortality of 2.29 per cent. Observations extended over eleven years and to date there has occurred but 1 anastomotic ulcer. Graham thought that the more radical the resection the less chance there was of recurring ulceration since the free hydrochloric acid was further reduced. There were no cases in which anemia was not found to be due to a deficiency in the diet. The resultant small stomach proved to be no handicap to the laborer. Lake (40), reporting on 320 cases in which the posterior Polya type of gastrectomy was performed for different conditions (in 198 for duodenal ulcer), found only 3 anastomotic ulcers two years or more subsequently. No cases of pernicious anemia developed and there was a marked general reduction in the acidity. He concluded that in cases of duodenal ulcer without obstruction and with high acidity subtotal gastrectomy is indicated.

HEMORRHAGIC DUODENAL ULCER

There is considerable variation in the estimates of the incidence of hemorrhagic duodenal ulcer. According to Balfour (4), 20 per cent of patients with duodenal ulcer coming to surgery have a history of hemorrhage. Wilkie and Ryle estimated that hemorrhage occurs in at least a third of the cases of duodenal ulcer; Babey and Hurst (2, 3) in 27 per cent; and Goldman in 38 per cent. Crohn said that 10 per cent of the ambulatory patients with ulcer and 25 per cent of the hospital patients with ulcer have a history of hemorrhage. Allen and Benedict (1) reported that a third of their series of 1,804 patients with duodenal ulcer required hospitalization because of bleeding.

The proportion of hemorrhage in men and women is about 6 to 1. In 90 per cent of the cases there was a history of duodenal ulcer of nine years' duration before the hemorrhages occurred. The onset of hemorrhage can rarely be foretold; it may occur following a particularly severe attack of an ulcer type of distress, but massive hemorrhages have occurred when the patient was having no distress of any kind, and in some cases a diagnosis of ulcer was not made prior to the onset of the hemorrhage.

The severity of the hemorrhage varies considerably. There is no question that hemorrhage from duodenal ulcer is a much more serious complication than is generally appreciated and that the mortality is higher than most realize. Umber (67) has reported a mortality from hemorrhage of 2.2 per cent for a series of 1,852 consecutive patients with ulcer. Babey and Hurst (3) estimated the mortality to be about 1.5 per cent, and Allen and Benedict (1) reported a mortality of 3 per cent from hemorrhage in their series of 1,804 cases of duodenal ulcer.

The mortality from hemorrhage in cases of duodenal ulcer, then, is probably from 1 to 3 per cent, the mortality in cases of bleeding duodenal ulcer being considerably higher. In 1935, for example, Tidy, Gordon-Taylor, and Turtle (66) on reviewing all cases of duodenal ulcer over a ten-year period at the Middlesex Hospital reported a mortality of 21 per cent for cases of duodenal ulcer in which the patients were admitted to the hospital with hemorrhage. About the same time Reschke reported a mortality of 9.8 per cent for a series of 1,023 patients with hemorrhage, and Umber (67) has reported a mortality of 9.5 per cent for 433 cases of duodenal ulcer with hemorrhage. Goldman (26) reported that 11.1 per cent of his patients with bleeding ulcers died of exsanguination and that an additional 4.9 per cent died of conditions associated with bleeding, or in other words a mortality of 16 per cent for patients with gross hemorrhage. Blackford and his associates (7) had a mortality of 11 per cent in their cases of massive hemorrhage from ulcer; Allen and Benedict (1) estimated 14.5 per cent; Tidy and his associates (66) 7.8 per cent; Hurst and Ryle (33) 4.8 per cent; and Lahey (38) about 5 per cent.

It seems obvious, since these reports vary considerably, that the criteria employed in evaluation have probably not been the same; but that the condition is more serious than has generally been appreciated, cannot be denied. All investigators have found that the highest incidence of bleeding is in the fifth decade and that the highest mortality is in the fifth, sixth, and seventh decades. Regarding age, Kruse (36) said that it was generally agreed that a greater proportion of persons more than forty years of age than of those less than forty die as a result of their hemorrhage, the ratio being 8 to 1. Allen and Benedict pointed out that in their series the average age of the patients who died was fifty-six and two-tenths years, whereas the average age of those who recovered was forty-one and eight-tenths years. They believed this finding of considerable value in guiding the type of treatment and in giving the prognosis in these cases. In 60 per cent of their fatal cases the patients died at the first episode of hemorrhage. Death from hemorrhage was rare among patients less than forty years of age. They concluded from this that advancing age with accompanying changes in the blood vessels is one of the greatest factors in mortality from hemorrhage in cases of bleeding duodenal ulcer.

There is considerable controversy regarding the treatment of hemorrhagic duodenal ulcer. Finsterer (19), Haberer, Tidy, Gordon-Taylor, and Turtle are among the chief advocates of surgical treatment; Meulengracht (48, 49), Hurst, and their associates advocate medical treatment.

Meulengracht based his treatment on the following observations:

1. Exhausted patients often die of hemorrhage in spite of scrupulous dieting.
2. Patients with protracted hemorrhage sometimes stop bleeding when given food.
3. Ambulant patients very often recover from severe melena without any particular change in their ordinary diet.

It seemed to him of questionable advantage to starve a patient at a time when he was in special need of support, and he believed it improbable that a diet insufficient in calories and vitamins was a proper means of healing ulcer. From 1931 to September, 1935, Meulengracht treated 251

patients with bleeding duodenal ulcer. His treatment consisted of giving the patient a full puréed diet with sodium bicarbonate, magnesium subcarbonate, and extracts of hyoscyamine, and ferric lactate. Patients were allowed to eat meatballs, boiled chops, fish-balls, omelette, meat and fish gratin, puréed vegetables, and fruit. They were allowed to eat as much as they wanted. A few patients were given blood transfusions on admission. Meulengracht compared his series of 251 cases, in which there was a mortality of 1 per cent, with 289 cases in which the patients were treated by Christiansen in the same city over the same period by the old starvation method, in which there was a mortality of 7.9 per cent. Meulengracht believed that many patients with bleeding duodenal ulcer died of exhaustion, and not of hemorrhage.

Hurst and Ryle's form of medical treatment consisted of starvation from forty-eight to seventy-two hours, large doses of morphine, and transfusions if the percentage of hemoglobin fell below 30. They pointed out that the mortality from gastric operations was higher than the mortality from bleeding duodenal ulcers and, accordingly, they did not believe that a surgical attack was justified. Tidy and his associates advocated medical treatment in the majority of cases, and after reviewing the cases of bleeding duodenal ulcer that he had observed he concluded that operation could not have reduced the mortality. Meulengracht's mortality of 1 per cent for 251 cases of bleeding ulcer is certainly the best result that has been reported and there seems no doubt that his treatment offers many advantages over the old and more conservative types of medical therapy. As yet, however, no extensive series of cases has been reported by others in corroboration of his results.

The matter of transfusion continues to be a controversial point. Kruse advocated transfusion when the percentage of hemoglobin dropped to 60. Hurst and Ryle, on the other hand, did not believe that transfusion was indicated until the percentage of hemoglobin had dropped to at least 30. Tidy, Gordon-Taylor, and Turtle favored collecting as many donors as possible in any case of hemorrhage and instituting a continuous blood-drip transfusion if the pulse was more than 100 beats per minute and if the percentage of hemoglobin was less than 50. Tidy and his associates pointed out that continuous drip transfusion is of great value in some cases, but that, at present, it is extensively overused, and especially in association with unnecessary operations. Christiansen has reported that although blood transfusion has been more widely used during the last five years, the death rate from hemorrhage from ulcer has been nearly twice that of the previous five years. MacGuire, Unger, and others held that the blood pressure never returned to normal for some time following hemorrhage and they believed that the clotting ability of the blood was improved by transfusion. Balfour (4) favored transfusion and thought that many lives had been saved by it. The need for maintaining the fluid balance to fight dehydration and acidosis was shown by Meyler. He also demonstrated that massive hemorrhage was followed by a tremendous toxic destruction of protein, with an accumulation of nitrogenous end-products and an increase in urea, and without a reduction in the blood chlorides or an elevation of the carbon-dioxide combining power.

Both delayed and immediate surgical treatment have been advocated for bleeding duodenal ulcer. Finsterer (19) was a strong advocate of immediate operation, pointing out that he had a surgical mortality of 4.3 per cent for a series of 46 cases in which patients were operated on within forty-eight hours of the onset of the hemorrhage, and a mortality of 32.7 per cent for 55 cases in which patients were operated on after forty-eight hours. Tidy, Gordon-Taylor, and Turtle likewise said: "if surgical attack on bleeding ulcer is being considered, the first forty-eight hours is the optimum time." The advantage of immediate surgical treatment is that the procedure can be carried out before profound shock, exhaustion, and malnutrition have developed. Allen and Benedict advocated operation during the quiescent stage after hemorrhage, believing that the patient could be more safely operated on after he had at least partially recovered from the shock of the hemorrhage. Allen and Benedict pointed out, however, that in cases of massive hemorrhage the situation was somewhat similar to that of pulmonary embolism in which even embolectomy becomes justifiable, and that in selected cases emergency operations may be imperative. They also pointed out that at autopsy in every one of these cases there was erosion of a large blood vessel by an ulcer on the posterior wall of the duodenum. These vessels were so large that there seemed little possibility that the bleeding would stop without surgical intervention. Umber likewise reported that at autopsy of 21 of 41 patients who died of bleeding duodenal ulcer a large eroded artery was found to be the source of the bleeding. Finsterer and Haberer advocated resection of the stomach, including the ulcer, in all cases. Others believed that removal of the ulcer was not neces-

sary if the blood vessels in the vicinity were ligated and if the ulcer was penetrating into the pancreas. Balfour (4) pointed out that 85 per cent of bleeding duodenal ulcers are cured by gastro-enterostomy alone. In selected cases, however, he believed excision of the ulcer or ligation of the blood vessels was indicated. Portis preferred excision of the ulcer or ligation of the bleeding points alone, with resection of the ulcer at a later time.

The results of surgical treatment seem quite satisfactory when patients are operated on early and if an appropriate procedure is selected for the individual patient. Finsterer took the reasonable position that statistics were of no assistance in judging single cases; in the end the patient must be treated according to the merits of the individual case. This we believe to be the soundest viewpoint.

One can therefore conclude from this review of the treatment of bleeding duodenal ulcer that the condition is an extremely serious one and that there is still room for a great deal of improvement. There is much to be said for medical treatment. The work of Meulengracht deserves further study and its possibilities need to be determined, particularly for younger individuals. There seems no question to us that transfusions are of inestimable value and have not, as Tidy and his associates and Christiansen suggested, been detrimental in the treatment of bleeding duodenal ulcer. There is also no question that in selected cases surgical treatment of duodenal ulcer is imperative. This is true particularly in cases of patients past fifty years of age who have massive hemorrhages, and in these cases we agree with Finsterer and Tidy, Gordon-Taylor, and Turtle that operation should be performed as soon as possible.

RESULTS OBTAINED BY VARIOUS SURGICAL PROCEDURES

Relief of pylorospasm and obstruction. It has been definitely established that pylorospasm is an important factor in both the production and persistence of duodenal ulcer and in the production of the symptoms which are associated with it. Wilson has shown that spasm of the duodenal cap and pylorus is always present during pain from duodenal ulcer. This spasm naturally produces a varying degree of epigastric distress and some pyloric obstruction. Both the medical and surgical treatment of duodenal ulcer must lead to efficient emptying of the stomach with absence of spasm in that organ and in the duodenum. Medically this can be accomplished in the majority of cases by gastric aspiration; by frequent small feedings; by the administration of alkalies, buffers, and other preparations which tend to inhibit gastric secretion; and by the use of antispasmodics, such as belladonna. Surgically, pylorospasm and pyloric obstruction may be relieved by direct surgical attack on the pylorus, such as pyloroplasty, gastroduodenostomy, or gastric resection, or indirectly by gastro-enterostomy. Pyloroplasty eliminates pylorospasm by division or resection of the pyloric muscle; at the same time the lesion should be removed if possible and a large pyloric outlet allowing free regurgitation of duodenal secretions into the stomach should be constructed. Theoretically gastroduodenostomy has much to commend it. The procedure can be performed safely and provides a large free communication between the stomach and duodenum. The disadvantage is that in cases in which it fails to maintain or control the symptoms, or in which a recurrence requires further operation disconnection of the anastomosis is difficult. Gastro-enterostomy relieves pylorospasm indirectly by diverting the gastric contents from the ulcerated, obstructed duodenum and allowing unobstructed passage of food from the stomach. Gastric resection accomplishes relief of pylorospasm by resection of the pylorus including the duodenal ulcer if possible, and by wide resection of the stomach with gastrojejunal anastomosis. Milanes (51) concluded, after a study of 70 cases in which subtotal gastrectomy had been performed for duodenal ulcer, that resection of the Finsterer type created genuine anti-ulcerous conditions; further, that it achieved satisfactory anatomical and physiological results and permitted relatively normal digestive and nutritional function; and, lastly, that it was vastly superior to gastro-enterostomy and was therefore the operation of choice.

Emptying time. The second principle of the surgical treatment of duodenal ulcer is that the operation must decrease the emptying time of the stomach; in other words, food must stay in the stomach a relatively short period so that there will be less stimulation of the acid gastric secretion by the presence of food and less gastric stasis. Pyloroplasty, gastroduodenostomy, gastro-enterostomy, and gastric resection, if properly performed, will result in a satisfactory emptying time of the stomach.

Strauss and his associates (65), however, have shown that the stomach should not empty too rapidly since, in their analysis of 35 cases in which subtotal gastrectomy was performed, they found that in those cases in which the emptying time

was from thirty minutes to three hours there was a better clinical result than in those in which the emptying time was from fifteen to thirty minutes. It is likewise known that the dumping type of gastro-enterostomies is not very satisfactory. Schindler was of the opinion that gastrectomies and gastro-enterostomies are followed by good results clinically if the new stomas function somewhat like a pyloric sphincter.

Reduction of the gastric acidity. Clinical and experimental research concerning the pathogenesis of gastric ulcer has indicated that the treatment which promises the greatest success is that which most effectively controls and neutralizes the acidity of the gastric content and excess gastric secretion, and at the same time corrects any impairment of the gastric function. Since a reduction in the gastric acidity follows almost any operative procedure which as a result of anastomosis between the stomach and duodenum or jejunum allows reflux of intestinal secretion into the stomach, it appears that a low postoperative gastric acidity is largely attributable to the dilution or neutralization which is produced by this reflux. This is substantiated by the fact that little reduction of the gastric acidity is accomplished if entero-anastomosis is also performed; but there is marked reduction after posterior gastro-enterostomy or the Polya resection when entero-anastomosis is not performed. Gage (24, 25) has said that entero-enterostomy should never be performed in conjunction with gastro-jejunostomy because the dilution and neutralization factor is lost by this procedure. Likewise, following pyloroplasty or gastroduodenostomy, or even gastric resection of the Billroth-I type in which the stomach is joined to the duodenum, the percentage of patients who have a marked reduction in gastric acidity is not so great as that when resection of the Polya type is performed. This is due probably to a lack of reflux of the duodenal secretion into the stomach following these procedures because the natural peristalsis carries the secretion onward; following gastrojejunal anastomosis without entero-anastomosis, however, the peristaltic force carries the jejunal secretion into the stomach.

Portis and Steinberg and their associates have been strong advocates of the theory that a regurgitation of the alkaline duodenal contents into the stomach was the most important factor causing a reduction in the gastric acidity. Hill and his associates (32) concluded from their studies on dogs, however, that neutralization by regurgitated intestinal fluids was not the major factor in lowering acidity following gastric operations, but that the pylorus was an important link in a mechanism which caused the fundus to secrete acid. Maier and Grossman (45) carried out a procedure on dogs whereby the entire duodenal content was regurgitated into the fundus of the stomach by sectioning of the jejunum and anastomosis of the proximal end to the fundus and the distal end to the end of the stomach, the duodenum being sectioned and the distal end being turned in. They concluded from these experiments:

1. In consideration of the rôle of acidity in the production of jejunal ulcers, the analysis of the gastric contents is a very unreliable guide.

2. The greater the regurgitation of intestinal contents into the stomach is after gastro-enterostomy or gastric resection, the lower the resultant gastric acidity, and therefore this regurgitation will not lower the acidity in the efferent loop.

3. Mechanical factors, such as kinks, stenosis, and muscular spasm, play a rôle in the formation of jejunal ulcer, and the details of the mechanical arrangement in each individual case will be an important factor in the determination of the amount of duodenal content regurgitated into the stomach after a gastric operation and hence may influence the chance of the formation of jejunal ulcer.

4. Considerable digestive disturbance may result from complete duodenal regurgitation.

Milanes reported that in 60 per cent of 70 cases in which resection was carried out for duodenal ulcer there was a satisfactory maintenance of regurgitation and a more or less permanent achlorhydria.

Importance of the pylorus and the gastric antrum. Removal of the antrum of the stomach does not seem to be necessary for the reduction of the gastric acidity since it contains none of the acid-secreting glands of the stomach. Its removal is included, however, in resections of the distal half to two-thirds of the stomach, including the pylorus, and Haberer and his followers have suggested that the antrum should be removed because they believe that it stimulates acid cells in the fundus to activity.

There has been a considerable amount of controversy regarding the importance of the pylorus in the maintenance of gastric acidity. Edkins was the first to point out that the pylorus in some way controlled the acid secretion of the stomach. Wilhelmj and his associates (73) have shown that the total amount of acid secreted by whole stomach pouches in cases in which the pylorus had been removed was from only a fifth to a sixth as much as in cases in which the pylorus was *in situ*.

Likewise it was shown that in the intact animal, following a partial gastrectomy including the pylorus, the acidity of the total secretions entering the stomach and of the gastric content was definitely lower than could be accounted for by the diluting and neutralizing effects of the duodenal secretions entering the stomach. After further studies Wilhelmj and his associates concluded that after removal of the pylorus, the concentration of acid fluids secreted by the fundic glands was unchanged; but that, owing to removal of the specific stimulating influence of the pylorus, the quantity of gastric acids secreted was definitely reduced. Lorenz and Schur have shown that removal of the pylorus decreases the production of gastric acid and lessens the probability of recurrent ulcer. Crohn has postulated that the pylorus contains nerve centers that stimulate the production of hydrochloric acid. Friedemann, reporting a series of 2,250 gastric resections for duodenal ulcer, noted a recurrence of ulcer in 4 per cent of his early cases and of only 0.5 per cent in his later cases in which he did a more radical resection, including the pylorus in every case. Spath and Friedemann have both reported recurrences after resection and have found that at subsequent operation removal of a pylorus lowered the gastric acidity and healed the ulcer. Milanes (51) insisted that the pylorus be included in resection in order to eliminate hormonal and nervous acid-stimulating factors located there. Engel (13) went so far as to say that if the pylorus could not be resected because of perforation of the ulcer into the pancreas, the mucous membrane should be removed anyway. Ogilvie (53) for some time advocated radical gastrectomy, but the pyloric antrum was to be left intact on the assumption that the anti-anemic factor originated in this area of the stomach. He has recently reported, however, that he has had a disturbing incidence of jejunal ulceration following gastric resection in cases in which the pylorus was left *in situ* and that he now removes the pylorus.

It is now more or less generally agreed, therefore, that the pylorus is probably the source of a hormone which stimulates acid gastric secretion. The only advantage of leaving the pylorus intact, apparently, is that some of the difficulties of closure of the duodenum are obviated, but if Engel's method of removing the mucosa without muscle is carried out, this is not a very serious problem.

In spite of the evidence that removal of the pylorus is necessary in gastric resections to produce a reduction in the gastric acidity, it is generally agreed that simple pylorectomy without extensive gastric resection does not lower the gastric acidity materially, and further that in cases in which the Billroth I resection was performed and in which the pylorus was removed a much higher incidence of recurrence of ulcer has occurred than in cases in which a like amount of stomach has been removed by the Polya method and in which the factor of dilution from regurgitation of jejunal contents was present.

It is generally agreed that if a resection is performed for duodenal ulcer, it should be an extensive one and that from at least half to two-thirds of the stomach should be removed. Strauss and his colleagues (65) have shown that resection of less than 30 per cent of the stomach does not lower the gastric acidity and that the results are not satisfactory unless the acidity is reduced materially. Engel believed that at least two-thirds of the stomach should be removed. Ogilvie recommended extensive resection because of the concept that acid secretion is reduced in direct proportion to the amount of acid-secreting cells removed. A more extensive resection should be performed in order to achieve a satisfactory reduction of the gastric acidity if the pylorus is not resected than is necessary if the pylorus is resected.

Removal of the duodenal ulcer. Removal of a duodenal ulcer does not seem to be essential for surgical cure, since ulcers heal rapidly following gastro-enterostomy when they are not touched. In gastric resection the ulcer is removed, if possible; but if the ulcer is of a perforating type any attempt at removal may seriously increase the risk, and this is not warranted. Removal of the ulcer apparently has little or no effect on gastric acidity. Bloomfield (8) advocated removal of the ulcer on the ground that it acted as a trigger zone for motor disturbances which produced discomfort.

In pyloroplasty or gastroduodenostomy the ulcer is usually removed, if possible; but since these procedures are best used in cases in which the acidity is low and in which there is some delay in the emptying time as a result of cicatricial stenosis of the pylorus, removal of the ulcer is not necessary. These procedures are of little value when the gastric acidity is high since neither the pylorus nor any of the acid-secreting portion of the stomach is removed and, as has been pointed out, there is very inadequate regurgitation of the duodenal contents into the stomach, and natural peristalsis carries the secretions forward.

After the Billroth I procedure, although both the pylorus and the antrum of the stomach are removed, the recurrence of ulcer is greater than

following the Polya type of resection. This is probably attributable to the fact that there is an inadequate regurgitation of duodenal contents just as following gastroduodenostomy or pyloroplasty.

Prevention of the recurrence of duodenal ulcer. The aim of all treatment of duodenal ulcer is to heal the existing ulcer and to prevent recurrence of the ulceration. Unfortunately, at present, there is no treatment, medical or surgical, that will heal and prevent a recurrence of ulceration in every case. As we have said before, from 50 to 75 per cent of the cases of duodenal ulcer can be handled satisfactorily by medical management, but it is necessary for the medical regimen to be followed carefully without remission or the ulcer will recur. Likewise, ulceration will recur in some instances after all types of surgical procedure, particularly if an adequate medical regimen does not follow operation.

Many surgical procedures have been devised to prevent the recurrence of duodenal ulcer. Pyloroplasty is one of the simplest and safest surgical procedures that can be carried out, and Judd found it to be applicable in 50 per cent of the cases. He reported 464 cases of duodenal ulcer in which pyloroplasty was performed with excision of the ulcer. Satisfactory results were obtained in 90 per cent of the cases; the mortality rate was 1 per cent. Finney and Hanrahan (18) obtained good results in 86 per cent of 251 cases in which pyloroplasty was performed with excision of the ulcer. Wilkie has likewise been satisfied with his results from this procedure. Snell (61) was of the opinion that while the procedure was extremely useful in the treatment of duodenal ulcer, it was followed by definite recurrence of ulceration in a small percentage of cases and that it was often extremely difficult to determine the presence of recurrent ulceration by roentgenological examination since the duodenum was deformed considerably by the procedure. One of us (Walters, 68) has pointed out that this operation does not lower the gastric acidity in a very high percentage of cases because peristalsis carries the duodenal contents onward rather than allowing free regurgitation as it is designed to do. One of the advantages of pyloroplasty, however, is that if secondary operation for recurrence is necessary, the previous procedure does not add materially to the difficulty or risk of a second gastric operation.

Gastroduodenostomy has apparently the same incidence of recurrence of ulceration as pyloroplasty and the indications for the procedure are practically identical. Like pyloroplasty, it theoretically has much to commend it. Both procedures are based on the concept that the tissues closest to the stomach should have the greatest resistance to irritation caused by the passing of acid gastric secretions and therefore, theoretically, they should be followed by a lower incidence of recurrence than procedures entailing diversion of the gastric content into the more susceptible jejunum. The disadvantage of gastroduodenostomy is that any secondary partial gastrectomy that may be necessary is often made quite difficult.

Gastro-enterostomy has been, and shows every indication of continuing to be, the most satisfactory surgical procedure for duodenal ulcer in most cases. As one of us (Walters, 69) has previously said, "Gastro-enterostomy will heal more ulcers at a lower operative risk regardless of size or shape of the lesion than any other procedure." The incidence of recurrence of ulceration following gastro-enterostomy varies considerably in numerous reported series. Marshall and Kiefer (47) have found the incidence reported to vary from 1.7 to 24 per cent and they believed that it was probably closer to the latter than to the former figure. Ogilvie said that recurrent ulceration follows in at least 20 per cent of cases in which gastro-enterostomy was performed, and Tidy, Gordon-Taylor, and Turtle believed that there was recurrence of ulceration in not less than 10 per cent of the cases. Newburger (52) reported an incidence of recurrence of 48.3 per cent for a series of 64 cases in which gastro-enterostomy was performed. Wright, on the other hand, reported an incidence of recurrence of 8.49 per cent for a series of 1,730 cases of duodenal ulcer. Balfour (5) reported an incidence of recurrence of 3.2 per cent following gastro-enterostomy at the clinic. Luff (42) reported on 995 cases of duodenal ulcer in which operation was performed by various British surgeons, the results of gastro-enterostomy being satisfactory in 89.5 per cent, general improvement following in all but a few cases, and the incidence of recurrence of ulceration being only 2.8 per cent. Maes and McFetridge definitely believed that the incidence of recurrence of ulcer following gastro-enterostomy was not as high as many believed. Walton (71), Heuer (31), Dinsmore, Finney (17), and Wilkie have expressed themselves as being satisfied with the results of gastro-enterostomy and other conservative procedures in the treatment of duodenal ulcer.

There is no question that for obstructing duodenal ulcers in the presence of low acidity, gastro-enterostomy is the safest and best surgical proce-

dure that can be performed. Gastro-enterostomy can likewise be used to great advantage in the treatment of many large perforating ulcers. Gastric acidity can be controlled very satisfactorily in the majority of cases by the dilution and neutralization of the acid gastric secretion brought about by regurgitated jejunal content. Relative achlorhydria is produced in a definite percentage of cases in which gastro-enterostomy is performed.

The incidence of recurrent ulceration has stimulated surgeons throughout the world to find some still more satisfactory method of treating duodenal ulcer, and the method receiving the greatest attention at present is gastric resection. That in selected cases it gives excellent results is beyond question, and more and more surgeons who have been dissatisfied with the results of more conservative procedures have turned to it. Lahey (37) has stated his opinion as follows: "It is certain in my mind that jejunal ulcer is too frequent, too difficult, and too dangerous a postoperative sequela to gastro-enterostomy to permit the operation to be employed as a routine surgical method of treating duodenal ulcer. There seems little question that the best surgical results, immediate and remote, are in those ulcer patients who postoperatively have a low gastric acidity or anacidity and that the operation which undoubtedly most consistently does this is extensive gastrectomy." Finsterer (21) has been an enthusiastic advocate of resection for duodenal ulcer, and at one time he reported 292 resections following which only 1 recurrent ulcer developed; this was cured by more extensive resection. The mortality for this series was 2 per cent (64). Ogilvie (53) has reported a combined mortality for primary gastro-enterostomy and secondary resection for recurrent ulcer of about 9 per cent. He took the stand that inasmuch as surgeons could perform resection with a mortality of 5 per cent, the operation of choice which would give the most satisfactory results is "physiological" gastrectomy. In regard to this Fogelson commented that he found it interesting to note that Ogilvie classified a surgical procedure that removed three-fifths of an important organ as "physiological."

That resection is not all that it was hoped it would be, however, is evidenced by an increasing literature containing reports of recurrences. Finsterer later admitted a definite recurrence, the cause of the recurrence following resection being the same as after any other form of treatment, medical or surgical, that is, failure to control gastric acidity. It goes without saying that there is tissue susceptibility to ulceration in any case in which recurrence develops after healing has once occurred. Klein, Aschner, and Crohn (35) have reported that relative achlorhydria was produced in only 56 per cent of 108 cases of resection for duodenal ulcer and that there was an incidence of recurrent ulceration of 8.3 per cent in this series. Berg has reported recurrence of ulcer following partial gastrectomy in 9 of 47 cases in which relative achlorhydria did not develop. Gastric resection is becoming increasingly popular as the surgical treatment of duodenal ulcer and many reports have been most encouraging; however, it must be remembered that it is a serious operation and cannot be taken lightly. Also, one must not forget that gastro-enterostomy is still a more conservative and safer procedure when properly performed on proper indications, giving results as satisfactory as those of surgery in almost any other field.

COMMENT AND SUMMARY

The problem of treatment of duodenal ulcer is still unsolved. No methods of treatment have been advanced that uniformly control gastric acidity in every case. Statistics seem to be of small avail in consideration of the individual case, and each patient must be treated according to the merits of his individual case and all the factors relating to it. Recurrence of ulceration in every case means that: (1) gastric acidity has not been adequately controlled, or (2) the patient is constitutionally predisposed to peptic ulcer and has a marked tissue susceptibility to ulceration. Tissue resistance to inflammation and ulceration from the hydrochloric acid of gastric secretion is what the successful surgical treatment of duodenal ulcer depends on, for if the tissue is resistant to hydrochloric acid, the patient will have a good result from the recognized types of surgical procedures without recurring ulceration; whereas if the tissue is susceptible to ulceration and if hydrochloric acid continues to come in contact with such susceptible tissues, ulceration will recur. Unfortunately there is no way at present to measure tissue resistance to acid gastric secretion.

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SURGERY OF THE ABDOMEN

ABDOMINAL WALL AND PERITONEUM

Jaeger, F.: The Non-Operative Treatment of Hernia (Ueber operationslose Bruchbehandlung). *Arch. f. klin. Chir.*, 1937, 190: 198.

The paraffin injection method of von Persing and Eckstein for the treatment of hernia was abandoned early. Velpeau in 1835 performed the first experiments in which cicatricial tissue was produced by the injection of certain fluids. In Germany this was done by Schwalbe in 1876 and later by Timmermann, Steffen, Wyss and Woltermann, and Birkenheier. In recent years this method of treating hernia has been recommended by many doctors in America, some of whom have done experimental work on animals on this subject. It has been shown that it is possible to produce strong scar tissue capable of closing hernias by the injection of certain fluids. The fluids are chiefly alcohol. In America the Piña Mestre solution which consists of catechu 15, monesia 14, krameria 14, rova canina 15, vaccin. myrtus 17, and alcohol (98 per cent) 25 is widely used. Usually up to 15 injections over a period of from two to three weeks are necessary. A truss must be fitted and worn for a long time before and after the injections until the scar tissue becomes solid. Timmermann advises three weeks on the average and uses from 0.5 to 8 c.cm. of absolute alcohol; but he sometimes injects for a longer period, even up to two years. All reducible hernias with the possible exception of postoperative hernias may be treated. The fact that true cures can be obtained was demonstrated by the findings in 5 patients previously injected who died of other diseases and came to autopsy with hernias which were found to be completely closed.

Steffens reported 4,632 cases of hernia, 1,548 of which could not be followed. He noted recurrences in 8.8 per cent of the 2,775 cases of inguinal hernia which were followed up. Ferreras noted recurrences in 2 per cent, Mayer, among 2,100 cases, in less than 2 per cent; Piña Mestre, among 8,000 cases, in only 1 per cent; whereas Millan and Cunningham noted recurrences in 8 per cent of 308 cases. According to some authors, however, the recurring hernias are also easily cured.

The complications are cellulitis (0.55 per cent), deep suppuration and fecal fistulas (0.7 per cent), and atrophy of the testicle (0.07 per cent); death occurred in 0.04 per cent, according to Wollermann. More frequent complications are described in the German literature by Magnus Goldhahn and Schmid. The Americans have abandoned the method of alcohol injection almost completely. Jaeger describes a case of intestinal obstruction in which many injections of mineral oil had been made previously, but nevertheless incarceration of the umbilical hernia occurred. Microscopic sections, of which there are 5 photographs, show the reaction in the adjoining tissue. The author emphasizes the fact that unfortunately injections have been frequently made by laymen who lack anatomical knowledge, and he concludes that it is obvious that the treatment by injection cannot compete with a carefully performed operation which leads to rapid recovery. This should not, however, stop the scientific analysis of results from the injection treatment of hernia. (Franz). John A. Gius, M.D.

Veal, J. R., and Baker, D. D.: Repair of Direct Inguinal Hernia by Osteoperiosteal Graft to the Pectineal Line of the Pubis. *Surgery*, 1938, 3: 585.

The authors state that for a hernia to occur through Hesselbach's triangle there must be either an anatomical variation in the insertion of the conjoined tendon or there must be a development of some weakness of the transversalis fascia and conjoined tendon in this region. The direct hernia pushes the transversalis fascia forward and the con-

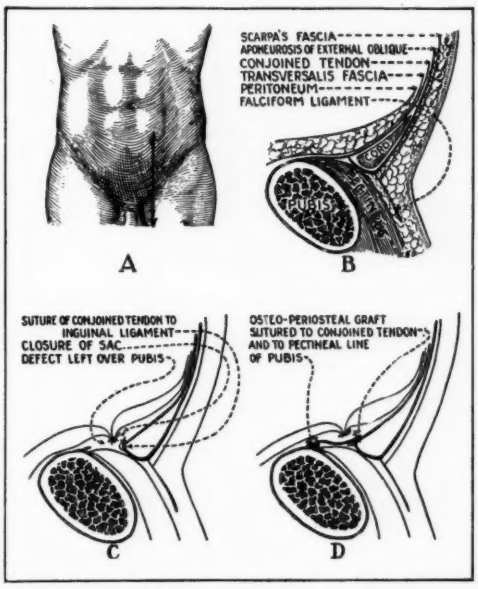


Fig. 1. *A*, arrows indicate position of sagittal sections *B*, *C*, and *D* 1½ in. lateral to the middle anterior abdominal line; *B*, the normal relations of shelving portion of the inguinal ligament to the conjoined tendon and the pectineal line of pubis; *C*, illustration of the defect over the pectineal line after the usual operation for repair of a direct hernia; *D*, showing the closure of defect by means of an osteoperiosteal graft.

joined tendon forward and medially. These structures become thin as the hernia enlarges. It may break through the transversalis fascia and displace or disrupt the attachment of the conjoined tendon to the pectineal line of the pubis. Such a hernia glides over the superior surface of the pubis since the strong sheet of the conjoined tendon normally present is missing.

It is the opinion of the authors that after the usual methods of repair of a direct inguinal hernia there still remains a defect over the pectineal line of the pubis. The normal support of this region is lost when the conjoined tendon is sutured to the shelving edge of the inguinal ligament. It is difficult or impossible to fix any surrounding structures, such as the rectus sheath or conjoined tendon, to the pectineal line of the pubis. The authors attempt to bridge this defect with a free osteoperiosteal transplant taken from the tibia.

An incision is made over the medial border of the tibia, from 8 to 12 in. in length. The anterior surface of the tibia is exposed. A full-thickness osteoperiosteal graft is removed. The upper portion of the graft is made the size and shape to fit into the defect over the pectineal line of the pubis. This portion of the graft is made the full thickness of the periosteum and also contains thin slips of bone. The long tail part is made up only of periosteum. The graft is sutured first to the divided periosteum of the pubis with from two to four sutures of chromic O catgut. It is then sutured to the posterior surface of the conjoined tendon. The long periosteal tail is used as a suture to draw the conjoined tendon down to the inguinal ligament. Two to four additional chromic No. 1 sutures are used to unite the conjoined tendon to the inguinal ligament. The cord is now replaced and the external oblique aponeurosis and skin are closed. The skin incision in the leg is then closed, no attempt being made to close the periosteum.

The authors state that this operation has been done on 14 patients since February, 1937. By means of x-ray and physical examination they have found that within three months the bone becomes absorbed and leaves fibrous scar tissue.

EARL O. LATIMER, M.D.

GASTRO-INTESTINAL TRACT

Annes-Dias, H.: Agastria: Pathogenesis and Clinical Aspects (L'agastrie; aspects pathogéniques et cliniques). *Presse méd.*, Par., 1938, 46: 411.

Annes-Dias notes that gastrectomy is being employed more frequently; at first used only in gastric cancer, it is now employed in gastric and duodenal ulcer, because it effects a radical cure without the danger of postoperative jejunal ulcer.

However, when an extensive gastric resection is done with the removal of from two-thirds to four-fifths of the stomach and the duodenal bulb, it is not only the secretion of hydrochloric acid that is terminated. Other important secretions and functions are abolished. These include, in addition to pepsin and the lab ferment: (1) the anti-anemic hormone; (2) secretin, which is produced normally by the action of the gastric acid and stimulates pancreatic secretion; (3) cholecystokine, the hormone studied by Ivy, which acts upon the bile secretion; (4) enterogastrin; and (5) incretin or duodenin, which stimulates the internal secretion of the pancreas.

When gastric digestion is abolished and the production of these various hormones which affect the entire digestive processes is stopped, various intestinal disturbances may result. The absence of hydrochloric acid results in the increase of microorganisms in the upper intestines and favors the invasion of the upper intestines by colon bacilli.

However, the most important after-effect of gastrectomy is undoubtedly the postoperative anemia. Numerous cases of this type of anemia have been reported in recent literature. The anemia may be of two varieties—true (hyperchromic and megalocytic) pernicious anemia, and hypochromic microcytic anemia. The latter type occurs after a considerable percentage of gastrectomies, according to recent reports, and especially in women. In some cases it has been found that the hypochromic microcytic form of anemia tends to become hyperchromic and pernicious as it progresses. Achylia is as typical of this type of hypochromic anemia as it is of pernicious anemia, whether the achylia is the result of gastrectomy or is a non-surgical achylia.

Lack of iron due to deficient absorption and absence of the gastric anti-anemic factor are the chief causes of the anemia following gastric resection. Other factors, such as deficiency of Vitamin B or an endocrine factor, are secondary. It is probable, as Morris has suggested, that if the iron deficiency predominates the anemia is hypochromic; if a deficiency of the anti-anemic factor predominates, the anemia is hyperchromic.

One case is reported in a woman, who after gastrectomy for a duodenal ulcer developed symptoms of hypothyroidism and ovarian deficiency, and also an anemia with both macrocytosis and microcytosis and a color index of 0.99.

The author is convinced that gastrectomy should not be employed as the routine treatment for peptic ulcer; its possible effects, and especially the danger of severe anemia, should receive more serious consideration.

ALICE M. MEYERS.

Moutier, F., and Debray, C.: The Juxtacardiac Region of the Stomach in Gastroscopy (La région juxta-cardiaque de l'estomac en gastroscopie). *Presse méd.*, Par., 1938, 46: 433.

Moutier and Debray note that when the gastroscope is introduced past the cardia, it enters a sort of antechamber of the stomach, and the visibility is limited. For better visualization air should be insufflated slowly and carefully. With patients lying on the left side, the posterior wall shows numerous folds; on the anterior wall the folds are much fewer.

Fig. 1. The subcardiac recess.

Fig. 2. The tumor-like ulcer.

Fig. 3. A sessile polyp.

The fundus may be seen in perspective, but the pylorus is too far away from the instrument to be clearly visible. The mucosa of the esophagus extends downward toward the lesser curvature of the stomach; its folds are longitudinal and the posterior wall of the juxtacardiac region at varying distances from the lesser curvature may appear like a diverticulum with which endoscopists should be familiar.

A recess just below the cardia may also be mistaken for a diverticulum; it is present in about 1 of 10 subjects and has no pathological significance. It is situated on the posterior wall from 3 to 4 cm. below the cardia; it is contractile and may show considerable variation during the examination; but surgical exploration has shown that this recess is not a true diverticulum.

Normal gastric contractions may begin in the juxtacardiac region; or there may be spasm below an ulcer or above a cancer. Gastritis may also cause spasm in the region below the cardia. In addition to annular spasms in this region, spasm involving only a segment of the wall may occur. Gastritis is often found in the region of the lesser curvature. Hypertrophic gastritis is not so frequent in this region as in the fundus; the gastritis is characterized most frequently by an erythematous appearance with pultaceous areas, and small erosions, scarcely visible. Atrophic gastritis may also be found in this region.

Gastric ulcer is not infrequently found within about 4 cm. of the cardia. The ulcer is surrounded, as a rule, by inflammatory tissue, so that it appears in the gastroscope as a more or less rounded mass of a dark red or sometimes a grayish color, somewhat like a malignant tumor; only careful observation will show the actual ulcer.

The upper part of the stomach is the site of predilection for benign polyps, especially on the anterior wall; these polyps may be flat, pedunculated, or sessile, and covered with normal mucosa. Cancer may be found in the juxtacardiac region, as well as in all other portions of the stomach. With cancer there is always definite infiltration of the gastric wall. When the cancer is advanced and projecting into the lumen, it is impossible to introduce the gastroscope further into the stomach. The tissue of these cancers is friable and easily broken down. Gastroscopic examination of the juxtacardiac region is of interest, because ulcer and cancer in this region often cause few symptoms clinically. ALICE M. MEYERS.

Wulff, H. B.: The Occurrence of Ulcer Carcinoma and of Carcinoma in the Stomach with Ulcer (Ueber das Vorkommen von Ulcuscarcinom und Carcinom im Ulcusmagen). *Acta chirurg. Scand.*, 1938, 80: 433.

The material studied was comprised of 609 confirmed cases of gastric carcinoma treated at the Surgical Clinic of Lund from 1924 to 1933. It was divided into two groups.

The first group consisted of 489 cases of gastric carcinoma in which there were no symptoms or findings suggestive of an ulcer prior to the development of the gastric carcinoma. In this series the history of symptoms ranged from no symptoms to symptoms over a period of three months for 26.7 per cent; from three to six months for 29.3 per cent, from six to twelve months for 27.3 per cent and for more than twelve months for 16.7 per cent. The presence of a previous ulcer in this group was not considered by the essayist.

In the next group of 120 patients the history, physical findings, or laboratory work suggested a previous ulcer. Sixty-nine of these 120 patients had long-standing digestive disturbances, but the picture was not typical enough so that an absolute diagnosis of gastric ulcer could be made. In the remaining 51 patients the findings were so characteristic that an ulcer diagnosis could be made with assurance. Twenty-eight of the latter 51 had characteristic pain occurring in the proper area and with the proper periodicity. Twenty-one of the 51 showed, in addition to typical ulcer pain, such characteristics of ulcer as hemorrhage, perforation, and niche formation. Eight of these 21 had ulcer hemorrhage over a period varying from two to thirty years prior to the

diagnosis of carcinoma. It was therefore possible to make a diagnosis of previous ulceration in 51 of 609 patients with gastric carcinoma; or in at least 8.3 per cent of the cases of gastric carcinoma treated in the Lund Clinic from 1924 to 1933, a previous diagnosis of either gastric or duodenal ulcer could be made.

It was of further interest to know that in 1911 Petrene collected from the same hospital 199 definite cases of gastric carcinoma which were treated from the years 1898 to 1908, and concluded that at least 8.5 per cent of the gastric carcinomas had been preceded by gastric ulcer. Carcinoma probably had an ulcer basis in 2.1 per cent of the cases. In 1.5 per cent this diagnosis of carcinomatous ulcer could be made and based upon histopathological examination. In 0.8 per cent the diagnosis could be verified by roentgen examination because an ulcer had been demonstrated previously at the site of the carcinoma, and in 0.2 per cent the diagnosis could be made both histopathologically and roentgenologically. SAMUEL J. FOGELSON, M.D.

Allen, A. W.: Total Gastrectomy for Carcinoma of the Stomach. *Am. J. Surg.*, 1938, 39: 35.

During the decade from 1926 to 1936, 713 patients with carcinoma of the stomach were admitted to the Massachusetts General Hospital, Boston. Of these, 254 were not operated upon, but 28 (11 per cent), died in the hospital. The majority of these were deemed inoperable after physical examination and roentgen-ray studies, and some after peritoneoscopy.

A considerable number were offered exploration but refused it. One hundred and sixty patients were subjected to exploration only because studies failed to reveal positive evidence of their unamenable condition. Thirty (18 per cent of these) succumbed before convalescence had progressed sufficiently for their discharge.

One hundred and five of the 713 had palliative operations, the majority of these being gastro-enterostomy. However, a considerable number had transections of the stomach proximal to a fixed growth and a posterior Polya anastomosis with the distal segment of the cut edge of the stomach turned in so as to leave the disease excluded. The mortality in the palliative group was 35 per cent.

In 176 cases, partial gastrectomy was done. These operations included all partial resections from excision of the antrum to subtotal gastrectomy. In a few an involved segment of transverse colon or pancreas was included in the resection. The mortality in this group was 33 per cent. End-results will be published on the survivors by Parsons and Welch.

In this past decade, 16 total gastrectomies have been done in this hospital; 5 patients were operated upon by the author, and in the remaining 11 cases 8 other members of the surgical staff participated. Fourteen of the patients had cancer of the stomach, 1 had lymphoblastoma superimposed on an old ulcer for which gastro-enterostomy had been done previously, and the remaining patient had a large benign ulcer that was thought to be cancer at the time of operation. Eight, or exactly half, of the patients survived the operation and left the hospital in a comfortable state of health. Five are still living at the time of this report, but 2 of them are believed to have had recurrences nine months and three years, respectively, after operation. Two are believed to be free of recurrence fourteen months and four and one-half years, respectively, after operation. The patient who had an ulcer is thought to be well although she cannot be traced at this time. The patient living the longest time so far had a highly malignant adenocarcinoma with metastases to the regional lymph nodes.

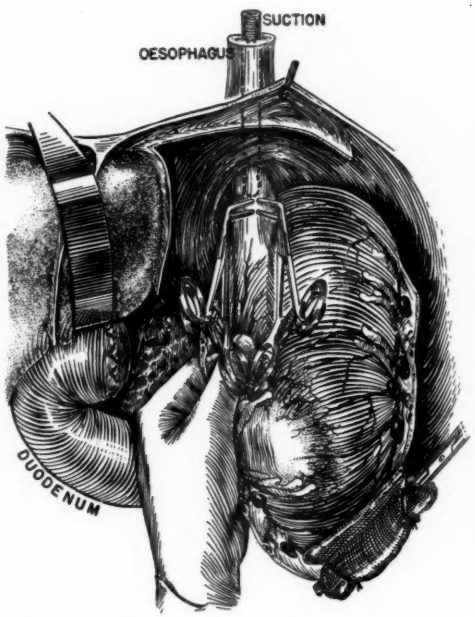


Fig. 1. Schematic drawing illustrating the exposure of the lower end of the esophagus. Note that Levine tube has been withdrawn from the stomach sufficiently to allow the tip to rest in the lower esophagus. The left lobe of the liver has been detached from the diaphragm and held out of the way by a flat retractor. (*Courtesy of Am. J. Surg.*)

An analysis of the operative technique employed on these cases, a study of the literature, and various suggestions that seem applicable have brought about a possible standardization of the operative technique for total gastrectomy, which the author believes may be carried out in suitable cases with a reasonable expectation of immediate success. It seems likely that an occasional five-year cure may be obtained, and in all cases the author has had the satisfaction of having offered these otherwise hopeless individuals a comfortable respite that is well worth while.

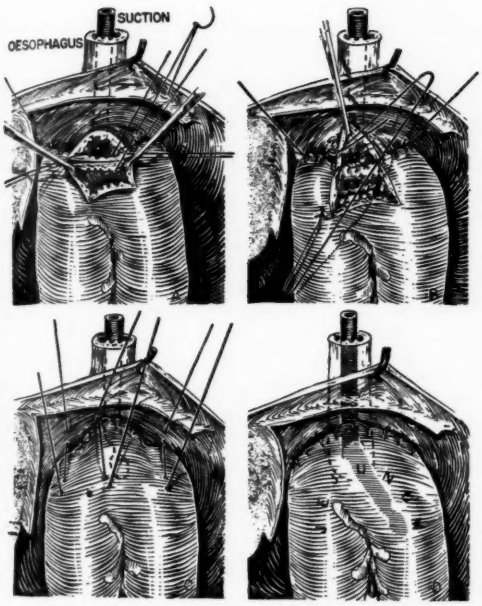


Fig. 2. Schematic drawings A and B, illustrating a careful approximation of the open end of the esophagus to all layers of the jejunum. The sutures are carried completely around the stoma inverting the mucous edges. C and D, the anterior wall of the jejunum is approximated to the diaphragm, completing the original circle of fixation sutures.

The type of anastomosis in relationship to the mortality in this group is suggestive. Three patients had esophagoduodenostomy and all died. The tendency of such a suture to separate and produce a fatal peritonitis was recognized by Finney and Reinhoff. Eight patients were operated upon in the manner described in detail below with only 2 operative deaths. One death occurred from peritonitis and pulmonary infection and the other from lobar pneumonia seven days after operation. In the latter case there was involvement of the transverse colon and pancreas which necessitated the removal of the whole stomach, a section of the transverse colon, the spleen, and two-thirds of the pancreas *en bloc*. A detailed report of this case record has been made.

OPERATIVE TECHNIQUE

Figures 1 to 3 illustrate the method which the author believes at present to be a logical procedure. He thinks the patient will withstand operation better if he is kept in the hospital several days for rest and the establishment of a fluid and salt balance. During this time, blood transfusions, glucose, and cevitamic acid are administered. With the patient at his best, the operation is planned so that time is no factor.

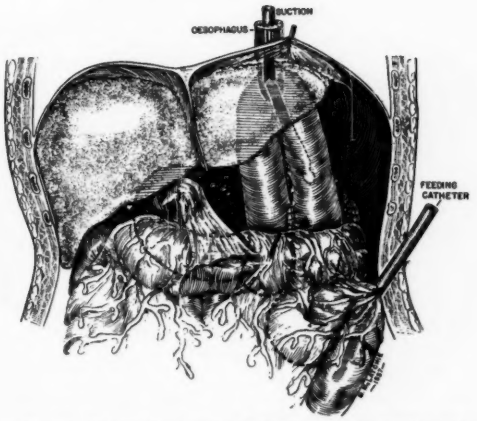


Fig. 3. Schematic drawing illustrating the Levine tube brought down through the esophagojejunostomy stoma into the distal limb of jejunum. The left lobe of the liver has been reattached to the diaphragm. An entero-enterostomy has been made at a low level between the jejunal limbs. A jejunostomy for feeding has been established.

The anesthesia can be local to the abdominal wall with splanchnic block, usually supplemented with nitrous oxide, oxygen, and ether in a closed machine. A well-given intratracheal anesthesia of the above mixture is ideal from the surgeon's standpoint, and in certain types of patients, particularly those with deep anteroposterior proportions, it may be best to use this from the onset. A Levine tube is introduced into the stomach before the anesthesia is started.

Postoperatively, the feedings should be put into the jejunostomy catheter for two weeks. This is done best with a continuous drip apparatus which should be regulated in such a manner that distention is reduced to a minimum. Normal salt solution or sterile water is used for the first forty-eight hours, then broth, dilute milk, and egg albumin are added. As soon as the patient is eliminating gas freely any liquid food can be used.

Stomatitis and diarrhea have complicated the convalescence in some of these cases. The author believes they can be eliminated by the administration of cevitamic acid before and after operation with regulation of the type of food introduced through the jejunostomy. High caloric mixtures should be avoided in the early feedings and non-gas-producing liquids used. In one instance, the author thought that the addition of dilute hydrochloric acid to the feedings helped to control the diarrhea. The patient is allowed a small amount of water by mouth after the third day. Feedings are begun and well established by this route before the jejunostomy tube is removed. The patient should be discharged on a well-balanced diet and should be urged to eat finely chopped meat and liver. It is surprising to see them gradually extend the time interval between feedings

and augment their ability to increase the amount of food taken at one time without distress. The patient in this series who has survived the longest number of years eats three substantial meals a day with only occasional feedings in between. He has maintained his normal weight, blood picture, and works regularly. He complains a bit about having to take most of his food in a finely divided form and gets some discomfort if he eats too rapidly.

J. THORNWELL WITHERSPOON, M.D.

Todyo, T.: Acute Intestinal Obstruction. *Ann. Surg.*, 1938, 107: 340.

The author presents a statistical survey of the cases of 342 patients with acute intestinal obstruction, who were operated upon during the last fifteen years.

Intussusception constituted 45 per cent of all cases of ileus.

The partial or total lack of fixity of the ascending colon to the posterior abdominal wall is considered a significant factor in the formation and development of intussusception. There were 154 cases of intussusception, in 38 of which it was found that the ascending colon lacked its normal fusion to the posterior abdominal wall in its entire length, and in 39 of which normal fusion was lacking in the upper first or second third of the ascending colon.

The average operative mortality in the entire series was 32 per cent; in the cases of intussusception alone it was 24 per cent.

The factors which may reduce the operative mortality in such cases are early diagnosis and immediate surgical interference in the earliest stage of the disease.

In severe cases of acute intestinal obstruction, surgical procedures must be reduced to the minimum. For this reason, the author has frequently produced an oblique fistula, by the use of a thin rubber tube. This procedure prevents the occurrence of a permanent fecal fistula, which is the result when a direct intestinal fistula is produced.

A special method of procedure which permits the earliest possible closure of the transverse intestinal fistula is suggested. SAMUEL KAHN, M.D.

Van Beuren, F. T., and Smith, B. C.: Acute Ileus. *Ann. Surg.*, 1938, 107: 321.

The careful study and analysis of a series of acute cases of ileus have been helpful in reducing the mortality in such conditions.

The factors chiefly responsible for the improvement seem to be: (1) earlier operation, partly due to routine pre-operative roentgenological examination; (2) a better understanding of the problem to be solved; (3) the more frequent use of spinal anesthesia; (4) greater replacement of fluid and electrolytes; and (5) the more frequent use of peristaltic drugs and rectal treatments.

Continued improvement in the results will probably depend largely upon earlier diagnosis.

SAMUEL KAHN, M.D.

Lagiadèr, H.: Experiences with Peritonitis Serum in the Treatment of Appendicitis (Erfahrungen mit Peritonitisserum in der Appendicitisbehandlung). *Helvet. med. Acta*, 1937, 4: 631.

In general the experiences with peritonitis serum in the treatment of appendicitis have been favorable. In Switzerland, also, Henschen, Nobel, Beck, and Barth are favorable, and only Urech has been unfavorable to this method of treatment. In the eight years between 1928 and 1935, 135 of 817 patients with appendicitis had perforations and showed beginning or far advanced peritonitis; 27 or 20 per cent of these died. From 1936 to 1937, 214 were operated upon; 49 of these had perforations and only 2 (4 per cent) died. One of these was a seventy-eight-year-old man who did not die of peritonitis but of marasmus, four weeks after operation. The author usually gives three doses of 25 c.cm. for two or three days, the first dose being intraperitoneal, the subsequent doses intramuscular, to prevent anaphylactic shock. Only in very severe cases of peritonitis are 6 injections of 25 c.cm. needed. The author mentions the rapid fall in temperature and the improvement both subjectively and objectively. The serum of the Swiss Serum Institute is preferred as it is a bovine serum and is mixed with serum antagonistic to the colon bacillus and the gas bacillus. Furthermore, it does not contain phenol.

In the discussion Urech states that he did not have any success in 315 cases, 21 of which were treated with serum. The mortality was 2.2 per cent as against 2.3 per cent in the years prior to the use of serum. In a second series, 480 cases were operated upon and in 15 serum was used with 3 deaths. Of 66 late cases serum was used in 16 with 6 deaths.

(FRANZ). JOHN A. GIUS, M.D.

Hosemann, H.: The Prophylactic Appendicostomy in the Treatment of the Most Severe Suppurative Perforative Peritonitis (Die prophylaktische Appendicostomie bei der Behandlung der schwersten eitrigen Perforationsperitonitis). *Arch. f. klin. Chir.*, 1937, 190: 164.

In contrast to the assumption of numerous physicians, the author does not consider toxicosis as the cause of peritonitic intestinal paralysis, especially not in its initial stage. He differentiates 2 types of peritonitic ileus: (1) the ileus from adhesions appearing weeks later, and (2) the ileus from agglutination appearing simultaneously or in association with the peritonitis. In the earlier stage of the peritonitis an ileus from adhesions is almost excluded, as in this case there is usually only a postoperative ileus from agglutination, which, as it is still fresh, separates spontaneously. It is not advisable to release these agglutinations operatively as peritonitis would be produced thereby.

In agreement with Hotz, the author considers the meteorism as the cause of the ileus, whereas the peritonitis is evaluated only as an associated phenomenon. The author differentiates the early peritonitic and the late peritonitic obstruction of the

bowel. He defines the former as a condition on the order of shock resulting from peritonitis after a sudden perforation of the organ. Like Petermann, he considers the loss of the intestinal activity in this stage as a sort of automatic protection, which prevents a dissemination by the absence of the peristalsis. However, the slight agglutinations resulting therefrom can lead to kinks and valvular closures because of the meteoric distention of the gut.

In contrast to the early peritonitic stage, only parts of the intestine are involved in the late stage, and drug therapy is not indicated, as a stimulation of the intestinal activity would lead only to more marked kinkings and valvular closures. The picture of the late peritonitic stage appears somewhat like this: the intestinal walls, stretched by distention, become permeable to bacteria and the peritoneum is flooded with highly virulent microbes and, furthermore, the blood vessels of the intestinal wall may be compromised by the internal pressure, from which necroses, gangrene, and perforation may result. Consequently, the ileus is the cause of the toxicosis and not the reverse, as is frequently assumed.

In 1902, Heidenhain used the postoperative intestinal fistula, which, if applied previously to the complete paralysis, often produces surprisingly rapid curative results. As a result of the elimination of the internal tension in the intestinal tube, the valvular closures open and the kinkings smooth themselves out spontaneously. Nature itself showed the way to the surgical treatment of peritonitis: there was frequently observed a strikingly rapid recovery from the spontaneous perforations of the suppurative exudate through the abdominal walls. With the later ventures to open the abdominal cavity, the now generally recognized surgical treatment of peritonitis became established. On the basis of numerous publications appearing already at the turn of the century, the author shows that recoveries from perforative peritonitis occurred at all times without intestinal suture.

Enterostomy has achieved its recognition in wide circles. The objections of its opponents, for example Sprengel, that after peritonitis there are many kinks that require several enterostomies, is disproved by Vollhardt: in this initial stage the emptying at one point of the intestine suffices to bring one intestinal coil after the other into activity. Another objection is the danger of inanition with the persistence of a fistula of the small intestine. The author replies that this does not apply to low enteric fistulas, as numerous cases in which such fistulas always closed themselves spontaneously show. In regard to the high enteric fistula there was danger until Witzel and Kader introduced the oblique canal with the rubber tube.

In a summary of the advantages of enterostomy the author shows that a primarily applied fistula, applied immediately at the first operation before the intestine could become paralytic, acts as a prophylactic and gives the best results. In contrast to the views of other surgeons, Hosemann supports the principle of doing enterostomosis in every severe suppurative diffuse peritonitis, even when it is not yet complicated by ileus. This intervention, supported by the infusion of ether, prevents the development of the dreaded late peritonitic intestinal paralysis. The author believes the objection to the prophylactic enterostomy (as one cannot be certain beforehand whether the reflexly paralyzed gut would lead to obstruction) to be repudiated by the fact that the inconveniences produced by the application of a fistula are very slight in comparison with the danger occasioned by the omission of this intervention.

With regard to the question, at what point the prophylactic enterostomy is to be applied, different answers are given: Sick mentions the lowermost part of the jejunum, whereas Keetley back in 1894 proposed the appendicostomy. In 1909, Wilms was the first German to define his position on this question by recommending appendicostomy because of its simplicity and great effectiveness.

In summary, the author shows that this method of the primary and, particularly, of the prophylactic appendicostomy has proved its advantage over the other methods by its brilliant curative results. Even when in a borderline case a postperitonitic ileus does develop, a high enteric fistula can at any time be combined with the appendicostomy. As to the results with the use of this method, the author reports that in 24 of 27 cases of the most severe diffuse suppurative peritonitis the patient could be saved.

The author also calls attention to the fact that the result of the appendicostomy is aided by a simultaneous, accurately dosed (50 to 100 c.cm.) infusion of ether. The infusion of ether has a favorable effect on the entire organism. Ducreux explains this effect theoretically as a complex result of bactericidal power, cardiovascular influence and hyperemia of the intestine, and stimulation of the peristalsis. (Seiring). Louis Neuwelt, M.D.

LIVER, GALL BLADDER, PANCREAS, AND SPLEEN

Uffreduzzi, O.: Two-Stage Operations on the Biliary Tract (Operazioni in due tempi sulle vie biliari). *Minerva med.*, 1938, 29: 169.

It is well known that patients with obstructive jaundice are poor surgical risks. This is due to a multiplicity of factors, such as the altered condition of the blood, the loss of detoxifying power of the liver, and the biliary stasis which predisposes to infection. These patients are therefore prone to hemorrhage, intoxication, and infection in the course of any surgical intervention.

Uffreduzzi suggests that in any case in which surgery on the biliary tract is contemplated, the functional capacity of the liver should be ascertained as accurately as possible. He admits that often this cannot be done because of the many factors entering into play and because of the unreliability of our liver-function tests. In general it may

be stated, however, that an icteric individual with complete biliary obstruction is more apt to develop hepatic insufficiency than an icteric individual with a partial obstruction.

The author believes that in cases presenting an obstruction of the biliary tract it is not a good plan to remove the obstruction by a one-stage operation. It is more rational to combat first the condition of increased pressure within the biliary tract and prevent the resulting harmful consequences. In these conditions, therefore, it is most urgent to re-establish the bile flow and to restore the normal pressure within the biliary tract by way of a fistula.

The bile should be allowed to flow to the exterior rather than to drain into the intestine because in the latter case toxic substances and bacteria will be reabsorbed into the system.

When the bile is allowed to drain to the exterior it is also possible to explore the biliary tract roentgenologically by the injection of lipiodol into the biliary fistula.

The author thus advises that the biliary operations be divided into two stages. The most commonly used surgical methods are cholecystostomy, opening of the cystic duct, or drainage of the latter through the gall bladder. In some cases it may be necessary to perform a choledochotomy and to insert a Kehr tube for drainage, but no attempt should be made to extract any stones which have become fixed to the lower segment of the common duct.

The interval which should elapse between the first and the second operation varies from case to case. The general criteria for proceeding to the second operation are indications, such as disappearance of the icterus, improvement of the patient's general condition, gradual subsidence of the fever, and, especially, improvement of the functional capacity of the liver.

The second operation will depend upon the individual case. Among a total of 9 cases the author performed a choledochotomy at the site of the stone in 6; a transduodenal papillotomy was performed in 2 because the stone was wedged into the papilla; and a choledochoduodenostomy was done in 1 case because the stone was extremely friable. The author recommends that if the stone cannot be dislodged it may be advantageous to transform external drainage into internal drainage by means of a cholecystogastrostomy. With these methods he was able to obtain very satisfactory results in his series of treated cases. RICHARD E. SOMMA, M.D.

Best, R. R., and Hicken, N. F.: The Therapeutic Value of Glyceryl Trinitrate in Biliary Colic and in the Postoperative Phase of Biliary-Tract Disease. *Am. J. Surg.*, 1938, 39: 533.

The histological study of the extrahepatic biliary system revealed more abundant muscle tissue in the fundus and neck of the gall-bladder wall than at the site where the cystic duct approached the common duct. The so-called "collum cysticus" sphincter was not identified. The hepatic and common bile ducts consisted mainly of fibro-elastic tissue with scattered strands of muscle tissue down to the region of the ampulla and the sphincter of Oddi, where non-striated muscle again appeared and reached its maximum thickness. It formed a sphincter which mechanically guarded the entrance into the duodenum, and which, clinically, induced a typical sphincteric syndrome.

Atropine, morphine and atropine, epinephrine, ephedrine, magnesium sulfate, and fats, such as cream or olive oil, were found to be effective, either individually or in combination, in relieving only a small percentage of cases.

The authors experimented with the use of glyceryl trinitrate in three groups of cases:

1. In ordinary biliary colic when the gall bladder had not been removed, glyceryl trinitrate gave relief in some cases and was a failure in others.

2. In the cases of patients whose gall bladder had been removed some years previously but who still had attacks of biliary distress, glyceryl trinitrate gave immediate relief when other anti-spasmodics had failed. With the use of this drug it was noted that small stones were released from the common duct, there being no relief if the stones were too large to get through the choledochus sphincter or were caught in a narrowed portion of the common duct.

3. In cases of patients with spastic biliary dyssynergia, who were carrying common-duct tubes or catheters and in whom the distress was caused by a disturbance of the sphincter of Oddi, glyceryl trinitrate often brought about immediate cessation of pain when the combination of morphine and atropine had not given the desired relief. Glyceryl trinitrate may be used in combination with morphine, as the relaxing effect of the glyceryl trinitrate on the sphincter seems to be greater than the spastic effect of the morphine on the duodenal wall. Atropine appears to give the most relief if the gall bladder and cystic duct are involved. When there is an active pathological condition, atropine or a combination of morphine and atropine has not always been found to be effective.

The greatest success with the use of glyceryl trinitrate has been obtained in those cases in which rather typical distress recurred following the removal of the gall bladder. RICHARD J. BENNETT, JR., M.D.

Ljvraga, P.: Hepatic Autolysis *in Vivo*; Biochemical and Bacteriological Studies on the Cause of Death from Hepatolysis (L'autolisi epatica in vivo. Reperti biochimici e bacteriologici della causa mortis per epatolisi). *Clin. Chir.*, 1938, 14: 75.

The publications on death from autolysis of the liver are controversial and center about two viewpoints: (1) the infective theory, particularly infection with anaerobes of the welchii type (Ellis, Dragstedt); (2) the theory pertaining to toxic products of cellular disintegration (Mason, Palmer, Salzmann). Some believe that a combination of these two factors is the cause of death from hepatic autolysis.

Andrews and Hrdina claim the cause is a toxic albumose; Mason and his collaborators think it is a peptone; and Palmer suggests that the fatal intoxication is due to polypeptids.

Regardless of the pathogenesis, all authors describe a severe toxemia or intoxication which causes profound anatomical changes in the liver and kidneys, which are designated clinically as the hepatorenal syndrome. Mason and Lemon stress the existence of a state of anhydremia, which causes death in experimental animals.

The author in his previous report has called attention to Eppinger's studies which suggested intoxication by allyl and tri-methyl-amine. These toxic amines are found in the urine and pus; the author has also demonstrated the presence of acrolein.

The author carried out experimental studies in dogs after placing autogenous implants of liver into the peritoneum. In particular, he was interested in these toxic products and made careful studies of the blood. He also made careful bacteriological studies on the liver after resection and implantation and in a state of autolysis. Eppinger has reminded us that bacterial contamination may be a post-mortem phenomenon.

Histologically, the author observed swelling of the Kupffer cells, serious lesions of the hepatic sinusoids with profuse hemorrhage into the acini and edema of the arterial branches and the walls of the veins. The author also observed inflammation of the serous membranes.

He discusses the possibility of molecular degenerative products of the liver which act as specific elective poisons with positive chemotaxis to the residual liver. Mascherpa has proved the reality of a positive chemotropism of proteins of an organ for the tissues of that organ in his studies on metal combinations of proteins with cobalt. Naturally, in the autolytic disintegration of liver parenchyma, degenerative products of liver proteins are formed. Thus Helwig and Orr demonstrated hypercreatinemia in their clinical and experimental studies on the hepatorenal syndrome; Jankelson, Segal, and Aisner demonstrated hypertyrosinemia in degenerative hepatic disease; and Ritter demonstrated a hyperamino-aciduria. The author himself found an increase in the residual nitrogen. The nauseating odor of autolysing liver indicates the presence of mercaptans probably derived from indole and skatole.

The renal lesions encountered were secondary to the hepatic changes.

In conclusion, the author notes that when a small piece of liver is left in the abdomen rapid and massive autolysis occurs. In this process highly toxic substances are formed which have an elective organotropism which induces necrotic, degenerative, and vascular lesions in the residual liver. This starts a vicious circle by throwing into the circulation degenerative products from the liver. This secondarily induces renal changes. These hepatic and renal toxic changes lead rapidly to the death of the animal. The peritoneal inflammation due to endotheliotoxins leads to anhydremia and serous inflammations.

Finally, the author concludes that death from hepatic autolysis *in vivo* depends on two individual factors: (1) toxic, and (2) hemodynamic. Bacteria play no decisive part in the mortality. There is also a probability of other acting causes as yet unknown.

JACOB E. KLEIN, M.D.

Rigney, L. J., Mortensen, W. L., and Miller, T. G.: The Diagnostic Value of Duodenal Drainage and of Cholecystography in Gall-Bladder Disease. *Am. J. Digest. Dis. & Nutrition*, 1938, 5: 1.

The authors made a diagnosis of cholecystitis, with or without stone, in the cases of 30 per cent of their patients who complained of digestive symptoms. Observation of a group of operatively proved cases indicated that duodenal drainage and cholecystography, together, rarely failed to be of aid in the diagnosis of gall-bladder disease.

In each of the authors' 137 cases, 1 or more satisfactory duodenal investigations and at least one, often three or four, reliable cholecystographic investigation was made previous to operation. When the question of function arose, the authors were inclined to record it as good, rather than as poor or impaired.

Operations for the removal of the gall bladder were performed in the cases of 120 patients, following which a microscopic and gross examination of the organ was made. The cases were unselected except for the elimination of those which, in a preliminary study, had been found unsatisfactory.

The cases are considered in two main groups: patients with stones (100), and patients without stones but with evidence of some gall-bladder pathology (37). Each group is discussed separately. A third group of 12 cases, made up of certain cases from the two main groups and composed of patients having gall bladders of the "strawberry" type, is also discussed. Included in the article are tables showing the age, sex incidence, diagnostic significance of various observations, and conflicting observations in the consideration of these cases by means of cholecystography, duodenal drainage, and operation.

In the diagnosis of gall-bladder disease, the authors believe that: (1) the history and physical signs are of great importance and may occasionally justify operative therapy even in the presence of negative roentgenological and biliary tests; (2) a positive diagnosis of stone in the gall bladder can be made on the basis of negative shadows in cholecystography, or, in not more than half of the cases, by the presence of cholesterin crystals in biliary drainage material; (3) by means of either of these tests a diagnosis of gall-bladder disease can be made in approximately 90 per cent of the cases with stone and in 50 or 60 per cent of those without stone, but that a strict diagnostic classification on the basis of the presence or absence of stone is frequently impossible; and (4) both tests should be employed

routinely in cases of suspected gall-bladder disease, as a check on information obtained from the history and physical examination of the patient. In some instances cholecystography, and in other instances duodenal drainage, will give important diagnostic aid. Together, they failed to be of help in only 3 of the authors' cases. EMIL C. ROBITSHEK, M.D.

Bazzocchi, G.: Alterations of the Contractile Portion of the Gall-Bladder Wall in Various Forms of Gall-Bladder Disease (Alterazioni della parte contrattile della parete della colecisti in varie forme di colecistopatia). *Ann. ital. di chir.*, 1938, 17: 23.

Bazzocchi examined 24 gall bladders presenting various forms of gall-bladder disease and after discussing in detail the normal histological features of the gall bladder, he studied the pathological alterations encountered in cholecystitis, cholelithiasis, and lipoidosis.

He found that the fundamental features of lipoidosis consist of hypertrophy and hyperplasia of the mucosal and muscular layers, whereas in cholecystitis and cholelithiasis he encountered a marked sclerosis of the gall-bladder wall.

In cases of gall-bladder lipoidosis, phenomena of dysfunction and dyskinesia predominate, whereas in cases of cholecystitis and cholelithiasis, inflammatory phenomena are apt to appear. Any combination of these two fundamental lesions may be encountered in the various forms of gall-bladder disease.

Bazzocchi believes that hypertrophy and hyperplasia of the epithelial portion of the gall-bladder wall must be considered as morphological expressions of its dysfunction. The sclerosis, on the other hand, cause an abolition of mobility and function of the gall bladder.

The reticular framework of the mucous membrane follows the same fate as that layer, and becomes hyperplastic and hypertrophied in conditions of lipoidosis, whereas it undergoes a scleroreticular or collagenic metaplasia in inflammatory or necrotic conditions. The histopathological aspects of the elastic portion of the mucous membrane vary in the various forms of gall-bladder disease.

The muscular layer undergoes the same changes as the mucous membrane and becomes hypertrophic in lipoidosis and atrophic or fibrotic in inflammatory conditions. The argyrophil reticulum of the muscular layer is divided into an interstitial and perimuscular portion. The interstitial layer follows largely the fate of the collagenic fibers, whereas the perimuscular layer follows the fate of the smooth-muscle cells. The elastic network is thickened if the collagenic fibers begin to show proliferative changes.

The subserosal layer presents features which are different from those encountered in the mucosa. It is soft, and in gall bladders with a marked mucosal hyperplasia, its volume is decreased. In gall bladders presenting a sclerosis and atrophy of the mucosa, on the other hand, the subserosal layer is thickened and infiltrated. The reticular network, which normally is very scarce, forms argentaffine aggregations in all places where infiltrates are present. The elastic fibers, which are normally quite abundant in the external layers, increase in number, especially in cases presenting a sclerosis or a pericholecystitis.

In general, it may be stated that the contractile portion of the gall bladder is always altered in these conditions, but the changes depend upon the individual type of gall-bladder disease.

The author points out that in the contractile mechanism of the gall bladder the smooth-muscle cells are of prime importance. Contrary to common belief, in all forms of cholecystitis without jaundice, the "colic" is not due to the possible presence of a stone, nor to a hyperkinesia, because of the fact that the contractile elements are almost completely destroyed. Also, the severe pain is not due to hyperdistension of the gall bladder because the rigidity of its wall is considerably increased.

RICHARD E. SOMMA, M.D.

Åkerlund, Å.: Progress in the Roentgenological Diagnosis of Gall Stones as a Result of Studies on the Conditions of Sedimentation and Stratification in the Gall Bladder (Die Verfeinerung der Roentgenologischen Gallensteindiagnostik durch Untersuchung der Sedimentierungs- und Schichtungsverhaeltnisse in der Gallenblase). *Acta radiol.*, 1938, 19: 23.

As in the author's article in the *Acta Radiologica* in 1933 on this subject (abstracted in *Internat. Abst. Surg.*, 1933, 57: 128), he still adheres essentially to the technique, and reiterates the thoughts, of that time. He supplements the subject of clinical possibilities with a wealth of new material and experimental evidence which tends to substantiate his theory that biles of differing specific gravities are the cause of the phenomenon of stratification. Fractions of bile, or even of plain water, containing different dilutions of the contrast material (thorotrast) and gall stones in a fresh stage, i.e., not yet dry and porous and surrounded by mucus, and composed of substances ranging all the way from the pure cholesterin (specific gravity 1040 to 1056) to the calcium stone of much higher specific gravity, were introduced into extirpated gall bladders, wax phantoms of gall bladders, and into living gall bladders, and roentgenograms were taken under conditions simulating those of the clinic.

From his studies the author concludes that although the heavy bile containing contrast medium and the lighter native biles do not mix completely in the gall bladder there is no abrupt demarcation, the materials of different specific gravities being suspended at different levels, and he constructs a schema illustrating his findings (Fig. 1).

Added clinical material demonstrates the assertion that in every case in which gall stones are suspected the new method will either rule out their presence with greater certainty, or, by the suspension on a line at a uniform level or by a half-moon-shaped sedimentation at the bottom of the gall bladder,

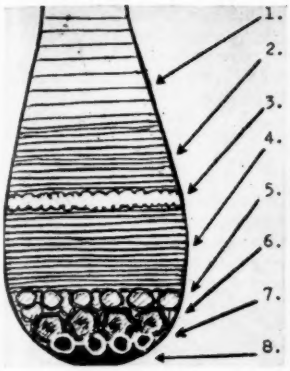


Fig. 1.

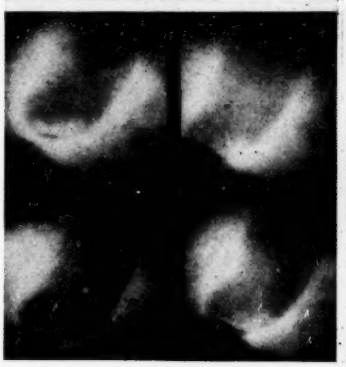


Fig. 2.

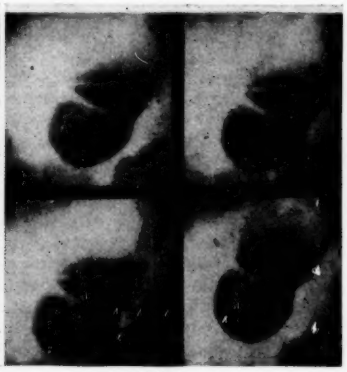


Fig. 3.

Fig. 1. Schematic drawing combining all the different types of stratification and sedimentation in the gall bladder: (1) native bile (bile containing no contrast material), (2) contrast bile (less highly concentrated), (3) suspended gall stones, (4) contrast bile (more highly concentrated), (5) concrements with small calcium content, (6) concrements with high calcium content, (7) completely calcified concrements, (8) amorphous calcium sediment.

Fig. 2. Fundus sediment with a half-moon-shaped agglomeration of tiny, transparent stones. At the bottom is seen a thin layer of amorphous calcium sediment (incipient "calcareous or limy bile").

Fig. 3. So-called fundus-diverticulum or hour-glass gall bladder. Horizontally suspended stratum, consisting of a large number of extremely small, cholesterin stones. A few hours previously the suspended layer of stones lay entirely beneath the obliquely directed infolding of the gall-bladder wall (fundus diverticulum). The diagnosis of stone was only possible by means of the sedimentation roentgenogram.

even of small transparent groups of stones, it will at times enable a diagnosis which could not otherwise have been made (Figs. 2 and 3).

JOHN W. BRENNAN, M.D.

Violet: The Surgical Treatment of Diabetes Mellitus; Its Basis and Possibilities (A propos du traitement chirurgical du diabète sucré; ses bases et ses possibilités). *Rev. de chir.*, Par., 1938, 57: 54.

The author reviews and evaluates the surgical procedures that apply to diabetes mellitus as reported in experiments on animals and in man. He believes that diabetes can be considered a disease of the regulatory mechanism of carbohydrate metabolism, and differentiates essential diabetes from symptomatic diabetes due to lesions of the pancreas, suprarenal glands, thyroid gland, parathyroid glands, hypophysis, or third ventricle. The fact is cited that in essential diabetes pancreatic lesions are rare and the insulin content of the gland is normal. Apparently the insulin present is not excreted in the blood because of lack either of endocrine or nervous stimulation. Attention is called to the fact that a depancreatized dog is not comparable to a human diabetic patient. This explains the conflicting results of animal and human experimentation, which are reviewed.

The possibility of surgical treatment of diabetes mellitus is based on the physiological classification of endocrine glands as hyperglycemic or hypoglycemic, and on our knowledge of the nervous regulation of carbohydrate metabolism. In order to increase the secretion of insulin, attempts have been made to activate the pancreas, to activate the salivary glands, to perform a sympathectomy of the pancreatic arteries, and to make pancreatic grafts. As far as their application to human diabetes is concerned, these attempts have met with almost complete failure. In the effort to depress hyperglycemic factors the attack has centered on the suprarenal glands and the thyroid gland. Only in the case of splanchnic section have promising results been obtained, and the reports are not unanimous. The author attributes the benefit described to the suppression of occasional sudden discharges of adrenaline which cause hyperglycemia. He points out that the operation has not been performed many times and that it is not without danger, but concludes that it may prove of value in certain severe cases with arterial complications. If the diabetic symptoms are secondary as apparently they are in certain cases of gall stones, pancreatic stone, and hyperthyroidism, beneficial results may be obtained from surgery.

WALTER H. NADLER, M.D.

Caldarera, E.: Acute Abscess of the Spleen (L'ascesso acuto della milza). *Ann. ital. di chir.*, 1937, 16: 953.

After having briefly reviewed the literature concerning acute abscess of the spleen, a relatively rare lesion, Caldarera reports the case of a fifty-four-year-old woman whose past history was essentially negative. The patient was admitted to the hospital complaining of tenderness and pain in the left hypo-

chondriac region accompanied by chills and fever. The pain, increasing progressively in intensity, radiated toward the lumbar region and also to the base of the corresponding side of the thorax. A tentative diagnosis of malaria was made and quinine was given; however this failed to bring relief.

On physical examination there appeared a considerable tumefaction of the upper left abdominal quadrant. A mass was felt extending from the costal arch, to the level of the umbilicus, downward and medially to the outer border of the left rectus muscle. Laterally the mass extended into the lumbar region. There was marked tenderness on pressure over this area accompanied by some degree of muscular rigidity.

In view of these findings a diagnosis of probable acute abscess of the spleen was made and the patient was laparotomized. After exposure of the greatly enlarged and adherent spleen an exploratory puncture was made which yielded a considerable quantity of purulent material.

The immediate postoperative condition was satisfactory and the patient made an uneventful recovery. Bacteriological examination of the purulent material removed at operation revealed the presence of colon bacilli in pure culture.

Concerning the pathogenesis of the condition, the author believes that splenic abscess may be secondary to a splenic infarct, trauma, and splenic torsion and ectopy. The causative organisms are usually the common pyogens such as the staphylococcus, the streptococcus, and the pneumococcus, as well as bacillus coli and ameba histolytica.

Splenic abscess has been reported to occur as a sequel of a great variety of infectious conditions, such as furunculosis, otitis media, erysipelas, staphylococcic osteoperiostitis, osteomyelitis, purulent salpingitis, appendicitis, gonorrhea, intestinal amebiasis, ulcerative endocarditis, pneumonia, typhoid and paratyphoid fever, puerperal infections, diphtheria, malaria, smallpox, and bubonic plague. Most commonly, typhoid fever produces splenic abscess.

The author also reports the results obtained from an experimental study performed with rabbits. He attempted to produce splenic abscess in one group of animals by traumatizing the spleen, whereas in another group of animals he produced an anemic infarct of the spleen by ligating the terminal branch of the splenic artery. Following the operation all the animals were inoculated intravenously with a broth culture of staphylococcus aureus. They all died within from two to seven days. It thus appears that splenic abscess may be produced artificially in animals when their spleens are rendered susceptible to infection either by trauma or by the production of an anemic infarct. The resulting lesions, however, are different: in the traumatized spleens there appears within the injured zone an aggregation of small abscesses which gradually enlarges and becomes confluent. In the infarcted spleens, however, the inflammatory process begins around the infarcted area, and the latter becomes gradually infiltrated and undergoes purulent changes.

The three cardinal clinical manifestations of acute splenic abscess are pain, fever, and splenomegaly, and the latter finding may confuse the diagnosis. The disease may begin suddenly or the onset may be insidious. Diagnosis is sometimes difficult, and the condition is most commonly confused with malaria from which it is differentiated by the negative blood smears. X-ray examination may prove very helpful. The prognosis of untreated cases is grave. Treatment is always surgical. RICHARD E. SOMMA, M.D.

GYNECOLOGY

UTERUS

Ducuing, J.: The Geneva Classification of Cancers of the Cervix (Sur la classification des cancers du col "de Genève"). *Acta radiol.*, 1938, 19: 13.

In 1926 the "radiological subcommission for cancer" of the Society of Nations, charged with the study of radiotherapeutic results in cervical carcinoma, were well aware that to establish exact and comparable statistics it was necessary among other things to divide the epitheliomas of the cervix into different classes depending upon their anatomical extension. Their classification with some modifications and concessions was finally adopted by the Society even though well known imperfections did exist.

The classification though incomplete has offered a possibility of accurately defining the results of radiotherapy of cancer of the cervix; and it should be in the interest of every one to co-operate in the improvement of this classification.

It is very difficult to set up a classification that is without fault: if based on the development of cancer in 3 stages it is too crude to be of any use in the study of the therapeutic results; if based upon these results themselves it must necessarily be made afterward and would vary with the progress of the treatment. The stages or classes here proposed are essentially certain anatomical and clinical states clearly defined as to shape and extension and thus valid for all forms of radiation, both for the present and the future.

In the classification of Geneva the author criticizes: (1) certain negative definitions, e.g., the placing in Stage III of all cases not falling into Classes II or IV; (2) the conception of mobility, which is difficult to define and difficult to relegate to its causative factor, infection or carcinoma; (3) certain faults with the subdivision within the different classes or stages, e.g., cancers with adenopathy and discontinuous propagation are placed in Class III instead of Class IV; and (4) the want of precision in the definition of a certain case in a certain class—it seems to the author that it is necessary to state: Class III (vagina), Class III (parametrium), Class IV (bladder), Class IV (rectum).

The following classification, presented by Ducuing himself, is also admittedly incomplete, but it is free of the criticisms just expressed:

A schematic representation of four stages of the author's classification of cancer of the cervix is herewith reproduced.

Class I. The cancer is strictly limited to the cervix. Palpation reveals beyond a doubt that the parametrium and vaginal insertions are free.

Class II. The cancer infiltrates the mucosa of the upper vagina, that is, the dome: Class II (vagina).

The cancer infiltrates the parametrium on one side or both without involving the pelvic wall: Class II (parametrium).

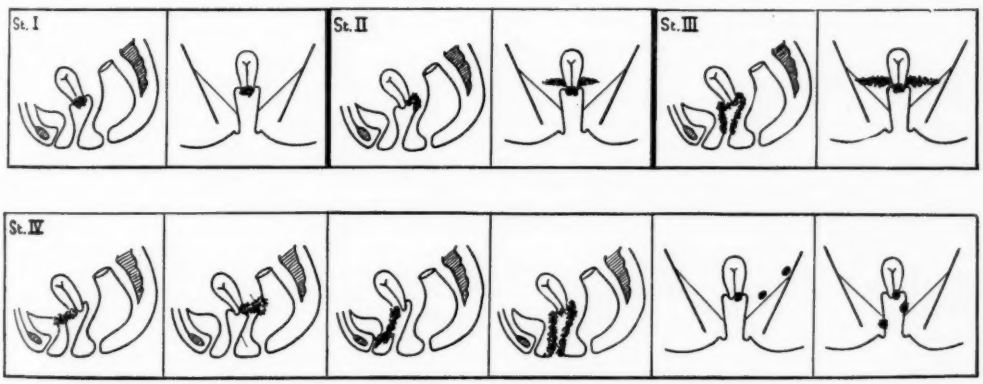
The cancer infiltrates the parametrium and the vagina under the preceding conditions: Class II (vagina-parametrium).

Class III. The cancer infiltrates the vaginal mucosa, extending downward but not to involve the vulva: Class III (vagina).

The cancer infiltrates the parametrium and the pelvic wall of one or both sides. Rectal palpation reveals continuation from the cervix to the pelvic wall: Class III (parametrium).

Class IV. The cancer infiltrates the bladder: Class IV (bladder).

The cancer infiltrates the rectum: Class IV (rectum).



The cancer infiltrates the urethra: Class IV (urethra).

The cancer infiltrates the vulva: Class IV (vulva).

There may also be extension into the pelvic ganglia or vaginal metastases which are separated from the primary lesion: Class IV (ganglia), or Class IV (vaginal nodules).

Class V. Metastases are present at a distance from the pelvis.

GEORGE C. FINOLA, M.D.

Arneson, A. N.: The Use of Interstitial Radiation in the Treatment of Primary and Recurrent Carcinoma of the Uterine Cervix. *Radiology*, 1938, 30: 167.

No single plan of irradiation is suitable for all patients with cervical cancer. If the percentage of cures is to be increased materially, both the roentgen and radium treatment must be individualized for each patient. The author favors a preliminary course of x-ray treatment for most patients because it tends to reduce local infection and thus lessen the local reaction from radium at a later date, and because the regression in the size of the growth facilitates the application of radium.

The present methods of applying radium to the uterus and vagina do not insure an adequate minimum dose, nor a proper distribution throughout the tumor-bearing region. Portions of the growth at greater distances than 3 or 4 cm. from the cervical canal cannot be treated adequately without serious damage to intervening or neighboring normal structures. The parametrial dose can be increased without the administration of excessive amounts of radium from any one source if a greater number of sources are distributed throughout the tumor-bearing area. Interstitial radiation, by the use of needles and seeds, is the most logical means of accomplishing this. The work of Pitts and Waterman in which these authors reported marked improvement in results by the use of interstitial radiation is quoted. Twelve to sixteen platinum needles, each containing from 2.0 to 4.0 mgm. of radium, were used. These were distributed throughout the cervical and paracervical tissues. Doses up to 10,000 mgm. hr. were administered. The mortality was 2.9 per cent. No particular difficulty on account of infection was experienced.

The author discusses 4 cases in which needles were employed in the treatment of primary or recurrent carcinoma of the cervix. Roentgenographs illustrate the distribution of the different sources in each patient. At first steel needles, each containing 12.5 mgm. of radium, were used. Later a change was made to sheath needles containing from 1 to 5 or 6 mgm. each, and with a wall thickness equivalent to 0.5 mm. of gold. The immediate reactions were quite favorable.

Emphasis is placed upon a predetermined plan of irradiation for each patient. This should take into consideration that from 3 to 4 threshold doses are necessary for the control of the disease. Isodose charts have been prepared for radium, which can be used in the same manner as depth dose charts for x-rays. The method of preparing the charts is described in detail. They present a fairly rapid method of determining amounts of irradiation required for delivering a predetermined tissue dose that is considered adequate for a given lesion. Of course the volume of tissue and its contours can be estimated only roughly and thus estimations of the tissue dose can be only approximate. However, such estimations insure individualization in treatment, and proper distribution is at least approached.

DANIEL G. MORTON, M.D.

ADNEXAL AND PERIUTERINE CONDITIONS

Portes, Aschheim, and Robey: Concerning the Differentiation of the Corpus Lutein of Pregnancy and of Menstruation (Sur la différenciation des corps jaunes gestatifs et menstruels). *Gynéc. et obst.*, 1938, 37: 100.

Although it has previously been affirmed that the corpus lutein of pregnancy and that of menstruation are identical, the authors contend that differential characteristics exist, some of which are relative, others absolute. Macroscopically, the corpus of pregnancy is larger and more deeply colored than that of menstruation. Histologically, there is a considerable difference in it in the early and late months of pregnancy, but in general the cells are larger and more irregular than in the corpus lutein of menstruation. Microchemically, calcium salts occur in the corpus lutein of pregnancy, but there is some difference of opinion whether the fat content increases or decreases.

The presence of colloid in the corpus lutein seems to be absolute in the state of pregnancy. Colloid in the corpus lutein of pregnancy was first described by Rabl. Many observers since then have found colloid present during pregnancy and absent in menstruation. The authors report similar findings in a large group of cases of their own, using formalin fixation, paraffin embedding, and staining with hematoxylin-eosin or iron hematoxylin, the Van Gieson stain, the latter staining colloid a yellowish brown. The colloid appears in the form of globules about the size of a red blood corpuscle, at times in the protoplasm, at times apparently extracellular. While the authors have found colloid present in the corpus lutein in every case of pregnancy, they have never found it present in the absence of pregnancy. They believe this is to be regarded as a secretion perhaps conditioned by the presence of gonadotropic hormones in the blood, perhaps regulated by the humoral diffusion of estrogenic bodies. They believe that the presence of colloid is so certain in pregnancy that it might be used in medicolegal diagnosis. Photomicrographs of colloid droplets in the corpus lutein of pregnancy accompany the article.

MAX M. ZINNINGER, M.D.

Norris, E. H.: Arrhenoblastoma. A Malignant Ovarian Tumor Associated with Endocrinological Effects. *Am. J. Cancer*, 1938, 32: 1.

The author reports the case of a patient who was followed up for more than four years and who finally died at the age of thirty-four. When she was first examined in January, 1933, her complaints included fatigue, nervousness, and generalized edema. It was found that she had a moderate hypertension. A short time later the hypertension was more marked, and glycosuria was discovered. These conditions improved under treatment, but later she became a psychopathic problem. Thorough examination at the Mayo Clinic revealed these pertinent findings:

There was a fine growth of hair on the upper lip; the back and chest were covered by pustules and comedones; the clitoris was not enlarged; there was edema of the face; a moderate hypertension persisted; there was mild secondary anemia, but the glycosuria could be controlled easily with insulin. No definite diagnosis was possible and she was placed under observation. Later, she lost all hair from her scalp and failed to menstruate. The edema of the face persisted and so did the evidence of mental disease. Eventually, a diagnosis of suprarenocortical syndrome was made, and bilateral hyperplasia, rather than tumor, was suspected. The adrenals were explored in May, 1934, and no tumor was found. There was some postoperative improvement in the symptoms for a few months, after which the swelling returned to the face, neck, shoulders, and arms; this was a brawny edema which did not pit. A few months later she again became psychotic and finally insane. This required incarceration in an institution for mental diseases. At that time it was noted that she had an extensive growth of hair on the face and there was a dark pigmentation of the skin. In March, 1935, x-ray therapy was started over the thymic area, although films failed to reveal an abnormal mediastinal shadow. Her condition seemed to improve following this deep x-ray therapy and for almost two years her condition was more satisfactory, but hospitalization again became necessary because of pain in the right lower chest, nausea, and vomiting. An exploratory laparotomy revealed a greatly enlarged liver containing multiple tumor nodules and slight ascites. She died in April, 1937.

At autopsy the edema of the lower extremities and of the face was quite marked. A brownish pigmentation on the back of the hands and feet was noted as well as the growth of hair on the face. A large tumor mass was found in the central mediastinum; it partially surrounded the great vessels. There were a few tiny tumor nodules in both lungs. The liver weighed 5,500 grams and contained many tumor nodules. The adrenal glands showed irregularity of outline due to previous excision of tissue for biopsy, and in the left gland there were two small tumor nodules. The uterus was infantile in type. The right ovary contained a small (15 by 12 by 11 mm.) ovoid tumor nodule which protruded from the surface. It was purple-gray in color in contrast to the ovarian tissue. The left ovary was normal except that it was firm, white in color, and had the general appearance of a gonad from an elderly woman. However, there were many follicles in the left ovary; some were atretic and others were in good condition. No gross lesions were found in the brain. The thyroid, three parathyroids, the hypophysis, and pineal body were also examined.

The ovarian tumor was made up of cords and block-like masses of epithelial cells. These cords and masses were very irregular in size and shape and were separated by a fibrous connective stroma. The epithelium of the tumor showed no tendency to form follicles, tubules, or glandular structures. As compared with the primary tumor, the metastatic lesions in the liver, lungs, kidneys, left adrenal, left ovary, and mediastinum were more dense and the cells showed less tendency to be distributed loosely. The epithelial cells of the tumor had little cytoplasm; the nuclei were relatively large, irregular in outline, and, for the most part, hyperchromatic. In less dense parts the cytological arrangement simulated a loose syncytium. The uterine endometrium, breasts, and scalp tissues all showed atrophic changes.

Among the large variety of ovarian tumors, there are only two which seem regularly to be associated with endocrinological effects; they are the arrhenoblastoma and the granulosa-cell carcinoma.

The term arrhenoblastoma is used to designate a small group of malignant ovarian tumors in which, through the action of what is thought to be a hormone produced by the tumor, defeminizing or masculinizing effects become manifest in the host. Consequently, arrhenoblastoma refers to a clinicopathological condition. This term can rarely be used as more than a presumptive clinical diagnosis, and less commonly can it be employed for a diagnosis based solely on histological study. Thus far, the world's literature includes 38 cases, but critical analysis permits only 29 of them to pass more or less rigid combined clinical and morphological criteria for the diagnosis of arrhenoblastoma.

This lesion is more prevalent in the third and fourth decades of life, but the reported cases range between the sixteenth and sixty-sixth years.

One must differentiate between symptoms which arise from the loss of feminine qualities and symptoms which are due to the development of definite male characteristics.

The early syndrome of defeminization is a persistence of amenorrhea with sterility. The breasts and endometrium atrophy, and the genitalia, with the exception of the clitoris, are normal or somewhat hypoplastic.

In masculinization, some degree of hirsuties is an almost constant finding. There may be a mustache or a beard, or even a generalized growth of hair on the face. Distribution of hair over the pubis, the lower abdomen, and around the nipples is of the masculine type. An extensive acne is common and the skin tends to become rough and darker than

normal. The facial expression is masculine because of the coarse features and bushy eyebrows. The skeleton is heavy and there may be an inversion of the normal pelvis-to-shoulders ratio of the female. In cases of long standing, the clitoris is hypertrophied.

As to the general nature of the condition, there is loss in weight of the patient, but at times there may be abnormal deposits of fat. Nervous symptoms of a variable type are usual. The psyche may be altered, but the heterosexual libido may remain unchanged until late in the disease. The pelvic tumor may be very large or very small, and there may be local pain and discomfort from the growing neoplasm or from its metastases.

The Aschheim-Zondek test is negative. Hyperglycemia and glycosuria may appear and disappear, as may also hypertension.

In general, the course of the disease is continuous and progressive. On the other hand, there may be an alternation of periods of symptomatic exacerbation and quiescence.

Early surgical removal of the tumor is the indicated treatment. The primary growth is unilateral. Arrhenoblastoma is evidently radiosensitive and irradiation may be useful in the management of postoperative recurrences. However, radiotherapy should be employed in maximum doses; smaller doses may have a stimulating effect on the neoplasm. After removal of the tumor the normal female characteristics return in a most dramatic fashion. As a matter of fact, normal pregnancy has followed operation in a number of the reported cases. If there is a recurrence of the tumor, remasculinization may occur.

In a previously normal female, the appearance of signs of defeminization and the development of outspoken masculine characteristics should certainly suggest arrhenoblastoma as a clinical possibility. The early clinical recognition of this lesion will, however, probably always be difficult. In the differential diagnosis one must consider (1) pregnancy, (2) postclimacterium, (3) tumor of the adrenal cortex, (4) Cushing's syndrome, (5) diabetes of bearded women, and (6) degrees of masculinization which are sometimes found in the entire absence of ovarian, pituitary, or adrenal lesions.

The case herein reported is apparently the first arrhenoblastoma to have run an uninterrupted course and to have come to autopsy, after which a careful microscopic study was made of all organs.

Regularly, only one of the ovaries is involved by the tumor. The opposite ovary is usually smaller than normal for the age of the patient. Arrhenoblastoma is definitely a malignant tumor showing a tendency to invade and metastasize. However, the tumor tends to grow slowly; recurrences and metastases appear late. The primary tumor may attain huge proportions or it may be of inconspicuous size. It may be solid or cystic.

Robert Meyer has attempted to divide arrhenoblastomas into three distinct groups on the basis of their histological structure: viz., adenoma tubulare testiculare, an atypical group, and an intermediate group. It is the author's opinion that these three groups cannot be recognized as separate and distinct morphological entities; he prefers to look on arrhenoblastoma as a malignant ovarian tumor, the morphological picture of which corresponds more or less to certain, some, or all of the varying structural conditions found in the indifferent stage of the development of the sex gland. There seems to be little direct evidence to support the theoretical conception that arrhenoblastoma springs from embryonic cell rests in the hilus region of the ovary; apparently it may arise from any portion of the ovary. It is doubtful if the pathologist can make more than a presumptive diagnosis of this tumor because pathological investigation has not yet progressed far enough to justify the final diagnosis of arrhenoblastoma without a knowledge of the presence of the characteristic clinical syndrome.

That a primary ovarian tumor of such undifferentiated state, and one which apparently corresponds to such an early genetic stage, should regularly produce a potent male sex hormone is more than remarkable. Speculation as to which cells are accountable for the secretion, or as to whether the hormone is derived from a tumor which had its origin in some cell rest supposedly made up of male directed cells, is valueless. Some future investigators may attempt the isolation of the hormone from this tumor and demonstrate its physiological activity. However, the fact that the effects produced in the ovaries of parabiotic experimental animals are similar to those found in the non-neogenetic ovaries of clinical cases of arrhenoblastoma provides a strong argument that a substance is produced by the arrhenoblastoma which is either the male sex hormone, or something very much like it.

The physiological state that is present with an arrhenoblastoma is best explained on the basis of intersexuality. Intersexuality is thought to find its explanation in disturbances or disharmonies of the endocrine glands. It is interesting to note that the hypophysis from this case of arrhenoblastoma showed the same histological picture as that constant anatomical change associated with Cushing's syndrome. In the adrenals there was marked hypertrophy of both the acidophil and pale cells of the cortex. The thyroid was in an extremely quiescent state. The pancreas, including the islands of Langerhans, was normal. The thymus was absent. The parathyroids and pineal body were normal.

GEORGE H. GARDNER, M.D.

EXTERNAL GENITALIA

Franche, O.: The Treatment of Vesicovaginal Fistulas (Le traitement des fistules vésico-vaginales). *J. d'urol. méd. et. chir.* 1938, 45: 11, 120, 205.

This is a comprehensive modern monograph on vesicovaginal fistula, including a historical résumé of

surgical treatments and a presentation of modern techniques and results, including Marion's successful plastic reconstruction of the urethra in severe cases with sphincter paralysis. The author stresses the need for a decision of (1) the best operative procedures in the various vesicovaginal fistulas in which the sphincter is conserved; and (2) the best treatment when the urethral sphincter is not functioning. Historically, Marion Sims (1849) is given credit for successful treatment by means of the vaginal approach. In 1881 Trendelenburg introduced the transvesical approach. In 1893 Dittel recommended the transperitoneal approach.

The author classifies the various surgical treatments of vesicovaginal fistula as follows:

CURATIVE METHODS

1. From below
   a. Vaginal approach (perineotomy);
   b. Vaginal approach, completed by parasacral, suprapubic, ischiorectal, or uterine plastic
2. From above
   a. Extraperitoneal approach (transvesical operation of Marion and sub-peritoneal operation of Bardenhauer)
   b. Transperitoneal approach (operation of Dittel, 1893, and transperitoneovesical operation of Legueu, 1912)
3. Combined approach
   a. Peritoneovaginal operation of Pousson, Fritsch
   b. Transvesicovaginal operation of Marion

PALLIATIVE METHODS

1. Episiorraphy of Vidal de Cassis (1844)
2. Colpocleisis of Simon de Heidelberg (1861)
3. Vesicovaginal-rectal cloaca operation of Maisonneuve (1851)

DERIVATIVE METHODS

1. Cutaneous drainage of urine
   a. Cystostomy (Israel)
   b. Double ureterostomy (Bachrach)
2. Implantation of ureters
   a. In the intestine (Coffey)
   b. In a newly formed bladder (Gersuny, Heitz-Boyer, Hovelacque)

An important point in operative indications is the existence or destruction of the vesical sphincter.

Pre-operative care is stressed. Rubiazol is favored as a urinary disinfectant. A Pezzer sound is placed in the fistulous tract and kept there while the operative area is treated, cleansed, and disinfected. Pre-operative cystoscopy is also useful when practicable. It is advisable to remove the Pezzer sound several days before operation to give the tissues a chance to return to normal.

As to the time between the appearance of the fistula and operative treatment authorities differ. One should permit the tissues a chance to return to normal conditions before surgery is attempted. Marion recommends a period of from six weeks to three months. The author then describes in detail with suitable illustrations the following operative procedures:

1. When the sphincter is functioning:
   Operations by the (1) vaginal route; (2) the transvesical route; (3) the transperitoneal route according to Dittel and Forgue; and (4) the transperitoneo-vesical route according to Legueu.
2. When the sphincter is injured:
   1. Closure of the bladder with reconstruction of the urethra as practiced by Marion. The technical details of Marion's treatment are described in detail, and include the postoperative care and possible complications.

In all Marion has operated on 95 patients. Of these 24 were operated on by way of the vagina with 87.5 per cent success; 50 through the bladder with 96 per cent success; and 21 cases with reconstruction of the urethra with 90 per cent success. These latter used to be considered incurable.

This contribution is a very valuable and instructive monograph on a very important subject.

JACOB E. KLEIN, M.D.

OBSTETRICS

PREGNANCY AND ITS COMPLICATIONS

Lambillon, J.: An Experimental and Clinical Contribution to the Study of the Physiology of the Posterior Hypophysis during Pregnancy and Its Relation to the Eclamptogenic State (Contribution expérimentale et clinique à l'étude de la physiologie posthypophysaire de la grossesse et de ses rapports avec la gestose éclamptogène). *Rev. belge d. sc. méd.*, 1938: 10: 1.

After making a study of the physiology of the posterior hypophysis during pregnancy the author draws the following conclusions:

1. The normal pregnant woman after the first trimester appears particularly refractory to the intravenous injection of 3 units of tonephine, the pressor fraction of pituitrin.

2. The pre-eclamptic patient presents, on the contrary, an exaggerated reactivity to the same injection much greater even than the normal non-pregnant woman or than the post-partum patient.

3. The nephritic pregnant woman reacts in the same manner as the normal.

4. In the case of a dead fetus or incomplete abortion, the woman remains insensible to the injection as long as the placenta remains viable; after expulsion or curettage she reacts as the normal delivered woman. This suggests that the placenta plays an important rôle in elaboration of the factor inhibiting the posterior hypophysis during pregnancy.

PAUL STARR, M.D.

McGowan, J. M., Baker, J. O., Torrie, A. M., and Lees, J.: Vomiting of Pregnancy: A Part of the Mechanism of Production and a Method for Its Relief. *J. Am. M. Ass.*, 1938, 110: 498.

Because of the close relationship between pregnancy and the origin of biliary disease, and because spasm of the second portion of the duodenum, produced by morphine, was accompanied in some cases by nausea or biliary colic, the authors made a study of the duodenum in patients suffering from the vomiting of pregnancy.

Roentgenological studies were made in the cases of two women. A spasm of the second portion of the duodenum was noted in each case.

Twelve consecutive patients who suffered from the vomiting of pregnancy were treated with glyceryl trinitrate (nitroglycerin), 0.01 gr. or 0.0006 gm. being placed under the tongue before or after meals. In these cases the condition was more severe than usual. All the patients had had morning sickness which progressed to severe vomiting. Five of them required hospitalization. It was only after the customary methods had failed that treatment with glyceryl trinitrate was started. The results were uniformly good. All patients ceased vomiting within two days of the onset of treatment; one patient did not vomit once after the drug was used. It was found that by the administration of the drug ten minutes before meals, more complete relief of the nausea was obtained than when it was administered after meals. No untoward effects, except a transient headache of a few minutes' duration, were noted. The patients were advised to remain in the prone position for ten minutes after the tablet was placed under the tongue.

CHARLES BARON, M.D.

Alfieri, P.: Clinical Research on the Pathogenesis of Pyelitis of Pregnancy (Ricerche cliniche sulla patogenesi della pielite gravidica). *Riv. ital. di ginec.*, 1937, 20: 613.

In the pathogenesis of pyelitis of pregnancy, urinary stasis in the ureter is the essential factor. Sfameni advanced the theory some time ago that a state of contraction and de-contraction of the urinary apparatus is produced by the hormones of pregnancy, elaborated by the ovary, the placenta, and the fetus. Bompini has recently demonstrated that urine from gravid women, up until four or five months of pregnancy, contains hormones which stimulate ureteral muscle tone and contraction; at seven months the hormones in the urine exhibit a paralytic action on the ureteral muscles, and as labor approaches an activating action of the hormones recurs.

The author believes that these results are clinically confirmed by the 46 cases of pyelitis of pregnancy collected at the Obstetrical Clinic of Parma from 1929 to 1936. Twenty-nine of the 46 cases, approximately two-thirds, occurred at the seventh month of pregnancy, 4 occurred before the fifth month, and only 1 after the eighth month.

The author could not concur with Sfameni that the sex of the fetus is a factor in the pathogenesis of pyelitis of pregnancy since 66.6 per cent of his patients gave birth to males and 33.3 per cent to females as against 56 per cent females and 44 per cent males in Sfameni's series.

GEORGE C. FINOLA, M.D.

Bendandi, G.: The Gall Bladder, the Female Genital Organs, Cholecystitis, and Pregnancy (Colecisti e apparato genitale femminile Colecistite e gravidanza). *Riv. ital. di ginec.*, 1937, 20: 517.

A clinical and experimental review of the literature on the influence of pregnancy and the genital function on gall-bladder disease is followed by an exhaustive clinicostatistical report on 1,000 cases of cholecystitis collected at the Surgical Clinic of Bologna from 1921 to 1937. Of the 1,000 patients 67.4 per cent had stones and 32.6 per cent had alithiasis; 90.5 per cent were females and 9.5 per cent were males. Eighty-five and nine-tenths per cent of the 905 females had had one or more pregnancies, while 12.9 per cent were nulliparous. Of the 610 women

with stones in the gall bladder 8.03 per cent had never been pregnant, whereas 90.49 per cent had had deliveries one or more times. In approximately 20 per cent of the cases the first clinical symptoms of the disease occurred during pregnancy, the puerperium, or soon afterward. The author believes that the data of this statistical study confirms the evidence in the literature that there is a certain influence of gestation on gall-bladder disease, and especially those gall-bladder infections with stones.

GEORGE C. FINOLA, M.D

LABOR AND ITS COMPLICATIONS

Gonfiantini, M.: Uterine Tone during Labor and Its relation to the Sympathetic Nervous System (Il tono uterino in travaglio di parto in rapporto al sistema neuro-vegetativo). *Riv. ital. di ginec.*, 1937, 20: 660.

The author reviews the literature on uterine tone during labor and then reports his experimental results with the hystronograph method of Fry on the tone of the uterine corpus and the lower uterine segment during the 3 stages of labor and the puerperium. In addition, all excitability reflexes, such as those shown by the pupils, pain, nasolacrimal region, skin, pilomotor and vagus nerves, and the tonus state of the body; trophic function, secretory function (perspiration and sebum), cardiovascular function, heart and vascular rhythm, thermal function, and arterial pressure were recorded, as well as their pharmacodynamic response to atropine, adrenaline, and pilocarpine.

Tabulated results are presented on 110 patients, 82 of whom had normal deliveries and 28 had operative deliveries.

Combining the results of his findings, the author was able to show that with normal delivery 45.25 per cent of the series had a reaction chiefly in the sympathetic nervous system, and 32.50 per cent chiefly in the vagus nerve, and in 23.25 per cent the two components of the autonomic system were in equilibrium. In the operative delivery group 57.14 per cent were vagotonic, 21.42 per cent sympatheticotonic, and an equal number were normal.

In the women with a sympathetic reaction the tonicity of the corpus uteri gave values much higher than those of the lower uterine segment. In the women with a vagus reaction the tonus state of the corpus was less than that of the lower uterine segment. In those with equilibrium of the autonomic system the tonus of the corpus prevailed.

Parturition was found to be more rapid when the sympathetic nervous system was inclined toward sympatheticotonia or normal, and slower in those patients in whom the vagus reaction predominated. In 57.14 per cent of the operative series the latter prevailed. A greater state of tonus in the corpus uteri than in the lower uterine segment also favored a rapid labor in these patients; with the reverse, labor was found to be prolonged.

GEORGE C. FINOLA, M.D.

PUERPERIUM AND ITS COMPLICATIONS

Moudrý, J.: Cerebral Hemorrhage and Hemiplegia in the Puerperium (Hirnblutung und Hemiplegie im Wochenbett). *Časop. lék. česk.*, 1937, p. 1335.

The author reports 2 cases of puerperal hemiplegia which were observed during the last five years in the Second Gynecological Clinic.

In the first case the patient was a thirty-eight-year-old para-iv, who complained of headache. A right hemiplegia with motor aphasia occurred in the seventh month, due to a cerebral hemorrhage. The condition improved in several days, and all the symptoms disappeared after three weeks. The Bordet-Wassermann reaction was strongly positive, and anti-luetic treatment was instituted. Delivery took place three weeks before term, and its course was entirely normal.

In the second case, the patient was forty-three years old, a para-v, who was totally disoriented on admittance, with flexion contracture of the right upper extremity and spastic extension contracture of the right lower limb. The blood pressure was 120/60. The urine was negative for albumin and sugar. Inasmuch as the membranes had ruptured, and since no internal examinations had been made, metreurysis was done and metralgin-quinin suppositories were introduced. After three and three-quarters hours, a full-term child was delivered, and the placenta ten minutes later. The neurological diagnosis was motor and sensory aphasia and right hemiplegia due to luetic endarteritis obliterans. The serological reaction was positive. The patient was discharged in an improved condition, after five weeks, to further home care. The following history was obtained from the relatives and attending physicians:

The first 2 pregnancies and deliveries were entirely normal; the third pregnancy terminated with the abortion of a macerated fetus in the fifth month, fifteen years ago. The course of the fourth pregnancy was entirely normal until the third month. Later, headaches and attacks of unconsciousness with generalized weakness occurred. In the fourth month the abortion of a macerated fetus occurred. After the abortion, the condition of the patient improved but three weeks later she developed unconsciousness, aphasia, and paralysis of the right side. In the present, or fifth pregnancy, headaches, vomiting, and attacks of unconsciousness again occurred in the seventh month. The apoplectic attack followed a week later. She was kept in this condition at home until her admission to the hospital.

Characteristic for both cases was the luetic etiology of the hemiplegia during pregnancy, and the rapid recovery with anti-luetic treatment, as has also been described in the cases of Arilazza, Miljan, Bonnet, and Renand.

Duhot divides puerperal hemiplegias into two groups. One group comprises hemiplegias which complicate pregnancy or delivery, but which are caused by a variety of diseases. In the second group

are cases of hemiplegia in which the most frequent cause is thrombosis or embolism following puerperal infection. A more practical division is one which separates the hemiplegias which are independent of the pregnancy from the true puerperal hemiplegias. The most frequent cause of typical puerperal hemiplegia is circumscribed cerebral hemorrhage, and less often thrombosis or embolism of the cerebral vessels. The causes of transitory hemiplegias are localized cerebral edema, spasm of the cerebral vessels, and toxic injury of the brain substance. Cerebral hemorrhage in toxemias of pregnancy are due to the damaged blood vessels, increased blood volumes, elevated blood pressure, and the colloidal blood changes. The delivery itself constitutes a mechanical factor, as in a case of Woltereck and Henriet.

In this group must also be included those cases with primary damage of the blood vessels or sclerosis. In the toxemias of pregnancy or eclampsia the hemiplegias occur during the second half of pregnancy (Galla's case). Non-eclamptic apoplexies usually occur during the second stage of labor. As a rule, there are extensive hemorrhages which lead to rapid death. Hemorrhages during pregnancy are much rarer. Their course is usually favorable. The symptoms and progress are to be interpreted in terms of the localization and extent of the hemorrhage, the phase during which it occurred, and the cause of the attack. The apoplexy has no effect upon the child, and it is not necessary to interrupt the pregnancy. With severe hemorrhage and a viable child, the question of cesarean section must be considered. In apoplexy during delivery, the most rapid and careful termination is indicated.

Although cardiac weakness plays an important rôle in thrombosis, the vascular changes of pregnancy and the trauma of labor must not be disregarded. Thrombosis may injure the brain substance, veins, and cerebral cortex. Arterial thrombi are rare, and are usually of luetic origin. Pareses due to thromboses do not develop as rapidly as those following hemorrhage or embolism. If localized areas of cerebral cortex are destroyed by embolism, the paralyses are often limited to monoplegias. In embolism during pregnancy or delivery no intervention is necessary except in moribund cases, in which cesarean section may be indicated for the sake of the child. From all the cases yet known it appears that most instances of puerperal hemiplegia are due to cerebral hemorrhage in toxemias of pregnancy, and fewer result from cerebral thromboses or emboli during pelvic infections. The smallest group of cases are those caused by various intercurrent diseased states of the cardiovascular apparatus.

Of the 56 described cases, 10 per cent were fatal, 30 per cent showed improvement, and 60 per cent presented complete recovery. Puerperal hemiplegias in the course of cardiovascular disease are most often associated with luetic endarteritis. The occurrence of the cerebral complications during the second half of pregnancy in these conditions indicates that the changes of pregnancy and delivery are contributory and not primary causes.

(Vidoković) Leo M. Zimmerman, M.D.

GENITO-URINARY SURGERY

ADRENAL, KIDNEY, AND URETER

Vintici, V., and Theodorescu, I.: Latent Hydronephrosis (Les hydronéphroses latentes). *J. d'urol. méd. et chir.*, 1938, 45: 143.

This is a clinical study on latent hydronephrosis, which is frequently mis-diagnosed. The authors describe latent hydronephrosis as a condition in which a pyelorenal dilatation of considerable volume occurs without apparent clinico-urological signs and is revealed only by the occurrence of a complication or various bizarre clinical syndromes. Maire of Lyon in 1938 wrote on the gastro-intestinal manifestations of latent hydronephrosis. In 1928 Holmann reported 4 cases of latent hydronephrosis: the first presented with symptoms of intestinal occlusion; the second as a hematuria and a diagnosis of renal neoplasm was made; in a third there was a huge kidney without clinical signs; and in the fourth the hydronephrotic sac ruptured without any previous urinary symptoms. MacMynn in 449 autopsies on children under ten years of age found in 10 cases a ureteral dilatation with hydronephrosis, unilateral or bilateral. The condition had been overlooked during life in 50 per cent of the cases. Rowlands reported 5 cases of hydronephrosis which in life presented the signs of a cholecystitis or an appendicitis. Gauthier and Clavel have reported on latent hydronephrosis with gastro-intestinal signs. They classify the "gastro-intestinal" forms of hydronephrosis as follows:

1. Chronic syndrome
   a. A dyspeptic form which simulates gastric or pyloric tumor
   b. An enteritic form which simulates mucomembranous enteritis
   c. A form of "chronic appendicitis" which is encountered most frequently
2. Acute abdominal syndromes in which the hydronephrosis can simulate intestinal occlusion or peritonitis

In 1935 Charles Howge assembled 32 cases from the literature of the past twenty-five years. The diagnosis had been made in 18 cases only; in 5 a diagnosis of ovarian cyst had been made. In 1 case hydatid cyst of the liver was suspected. In another the diagnosis was bacillary peritonitis and in still another, retroperitoneal cyst. It is readily seen that latent hydronephrosis is not a well known condition.

The author reports briefly his own 4 cases, and presents excellent pyelograms as illustrations. He notes that the pathogenesis of hydronephrosis is a controversial question; but in his own cases a congenital origin seemed most likely. A congenital stenosis of the ureter may induce a progressive latent hydronephrosis until there is a complete destruction of renal function. In 2 of the cases there was a faulty implantation of the ureter; in a third there was a bilateral ureteropyelorenal dilatation without a vesico-ureteral reflux. In the fourth case there was a voluminous, latent congenital hydronephrosis, secondarily infected with the bacillus coli.

The latency of the symptoms is explained by a tendency toward relaxation on the part of the muscular fibers with a resulting gradual slow symptomless dilatation of the urinary tract. Such voluminous hydronephrotic sacs are brought to attention accidentally because of secondary infection or variable urinary or digestive symptoms.

As concerns the symptoms, most of these congenital pyelorenal dilatations develop without clinical manifestations for a long time. Besides the aforementioned gastro-intestinal symptoms the authors point out a urethroprostatovesical syndrome without renal signs, with clear urine or a mild pyuria. Sometimes there is a nocturnal or diurnal pollakiuria. Again there may be a persistent pyuria.

For diagnosis chromocystoscopy with indigo-carmine indicates a poorly functioning kidney. The blood nitrogen is normal but the phenolsulfonphthalein is diminished. This triad of symptoms, renal deficiency on chromocystoscopy, diminution in the elimination of phenolsulfonphthalein, and normal blood nitrogen establishes the diagnosis of pyelorenal dilatation. This diagnosis is confirmed by pyelography and urography. For ascending pyelography the authors use 10 per cent sodium iodide.

The evolution of the hydronephrosis may take a long time. It may be found only at autopsy, not having been diagnosed during life. The complications of hydronephrosis are infection, and rupture of the hydronephrotic sac. The former is most frequent. Infection leads rapidly to sclerosis and functional destruction of the kidney. Rupture of the sac may occur from trauma or after exploration. The clinical symptoms in this instance are those of peritonitis or some other abdominal syndrome. Thus the existence of latent hydronephrosis may be important from a medicolegal standpoint.

Conservative surgery is usually favored in the treatment. This includes various plastic operations and transrenal drainage. Nephrostomy produces considerable improvement in the general health and considerable diminution of the renal sac. Renal drainage cures stasis and inhibits infection.

JACOB E. KLEIN, M.D.

Ciceri, C.: Hydronephrosis Due to Anomalous Blood Vessels (Contributo allo studio della idronefrosi da vaso anomalo). *Arch. ital. di urol.*, 1938, 15: 1.

Anomalies of the vessels in the renal pedicle have been known for a long time, but in recent years they have received considerable attention as a cause of hydronephrosis. Anomalous vessels in the renal pedicle are a result of embryonic development.

As to the pathogenesis of hydronephrosis one theory states that there is a stasis of urine in the

pelvis of the kidney as a result of pressure from an anomalous blood vessel. In addition to the pressure from this vessel a valvular compression of the ureter against the wall of the renal pelvis occurs. Some authors also assume the presence of a concomitant inflammation in the wall of the renal pelvis. Forni reported 5 cases in which he found inflammation of the pelvis, calyces, and the cortical and medullary substance. He thinks that inflammation is not the effect but the cause of the hydronephrosis. He believes that remittent hydronephrosis is due to an inflammation of the renal pelvis and ureter, and secondary inflammation of the kidney. Marion is convinced that ptosis exerts an important influence in the pathogenesis of hydronephrosis, especially when the ureter is fixed by anomalous vessels.

A second theory asserts that the determining cause of hydronephrosis is a congenital alteration of the wall of the pelvis and the ureter, and that the anomalous vessels are of secondary importance. Also Bard recently has affirmed that hydronephrosis is secondary to a true disease of the tissues which constitute the walls of the pelvis.

A third theory, supported especially by Israel, Fedoroff, and Legueu, attributes great importance to dyskinesia of the pelvis, as a result of which there is a disturbance in function of the musculature of the pelvis. According to Legueu a chronic stage of muscular retardation is followed by a progressive dilatation of the pelvis, which may be followed by an acute attack, characterized by muscular spasm. The latter reaction is followed by a complete lack of pelvic contractions with atony, dilatation, and complete urinary retention. Even in the pathogenesis of this dynamic form the presence of an anomalous vessel can have considerable importance as a source of irritation which disturbs the normal function of the musculature of the renal pelvis.

The author has studied 12 cases of hydronephrosis with anomalous vessels; 2 were in males and 10 in females. One case occurred in the first decade of life, 1 case in the second, 6 cases in the third, and 4 in the fourth decade.

The clinical symptoms presented the classical features of intermittent hydronephrosis; namely, pains in the lumbar region, followed by a considerable excretion of very pale urine. Only 2 of the patients had hematuria.

Clinical examination in all of the patients revealed the existence of a renal ptosis. During a colic these patients showed abdominal rigidity, and pain on pressure over the upper ureter, on lumbar percussion and on renal palpation. In every case endoscopic and radiologic examination completed the diagnosis.

In all the cases which were operated upon the kidney was found to be ptosed; and in some it was fixed in an abnormal position by perinephritis. The author observed various degrees of dilatation of the pelvis and calyces, and the ureter was dilated at the point where the anomalous vessel encroached on it. In 3 cases the pelvic dilatation was most marked. The author examined histologically fragments of kidney removed at operation and found dilatation of the glomerular spaces and uriniferous tubules, lymphocytic infiltration about the blood vessels, and slight hyperplasia of the interstitial connective tissue. The blood vessels which were examined were normal. No doubt the renal changes depended entirely on the gravity, duration, and frequency of the urinary crises in the pelvis. Experimentally it has been demonstrated that after a urinary stasis of twenty days the kidney cannot recover its normal anatomical and functional characteristics. In fact the functional and anatomical changes in the kidney and pelvis were most severe when the occlusion of the ureter had been most prolonged and frequent.

Surgical therapy of this type of hydronephrosis may be classed as conservative, partially conservative, and radical. Conservative treatment consists of ureteral catheterization, nephrostomy, or pyelotomy. Resection of the constricting blood vessel is not favored by most authors because it may lead to parenchymal necrosis of the kidney. In advanced cases nephrectomy is advised.

In the author's cases section of the anomalous vessel was practised together with nephropexy and severance of the perirenal and periureteral adhesions. Good results were obtained. It was not found necessary to do plastic operations on the pelvis or ureter.

JACOB E. KLEIN, M.D.

Smith, G. G.: The Surgery of Renal Tumors. *J. Urol.*, 1938, 39: 308.

In a consideration of the operability of renal tumor multiple metastases are important. A single metastasis may be disregarded if it is amenable to irradiation or, if in an extremity, to amputation. Anemia and cachexia may preclude operation. The size and fixity of the tumor do not necessarily contra-indicate operation; pre-operative radiation may reduce the size of the tumor to within the limits of operability. Size alone is not an insurmountable obstacle.

The surgeon should learn as much as possible about the characteristics of the tumor and the patient's condition before the operation. A retrograde pyelogram will indicate whether the tumor is of the cortical or pelvic type. Roentgenography of the intestine may show invasion of the latter. The function of the other kidney should be ascertained. Pre-operative radiation should be reserved for tumors which, because of their size or fixity, appear to be unusually difficult to remove. There is still considerable difference of opinion as to its true value.

Either the lumbar or the transperitoneal incision may be used. The author has used both an equal number of times. Indications for the lumbar route are: (1) uncertain diagnosis; (2) small size of the mass; and (3) the probability that the growth is of the pelvic rather than the cortical type. Large cortical tumors are removed transperitoneally. Removal of the eleventh and twelfth ribs, as well as the extension of the lower end of the incision transversely across the abdomen enlarges the operative field. Various incisions are employed for the transperi-

toneal operation. The author uses the Cabot incision extending from the anterior edge of the erector muscles in the costovertebral angle inward and slightly downward to the midline just above the umbilicus, then carried upward in the midline to the ensiform process. Upon walling the intestines away from the upper abdomen, the tumor can be exposed through an incision of the overlying peritoneum, or through an incision of the parietal peritoneum an inch outside of the colon, which is then rolled inward with the posterior peritoneum and exposes the renal fossa.

Removal of the kidney should not be begun unless the appraisal of the situation has led the surgeon to believe that he can complete the nephrectomy. The renal pedicle is isolated and ligated, and the kidney is removed, together with the surrounding fat. The peritoneum is then sutured in place, and the renal fossa drained through a stab wound in the flank. This description applies almost entirely to cortical tumors.

With tumors of the renal pelvis, removal of the entire ureter together with the portion of the bladder through which the ureter passes is important. In 6 of 7 of the author's patients with ureteral growths, there was a tumor either in the intramural portion of the ureter, or arising from the ureteral meatus. Removal of the lower segment may be done at once or deferred for a second operation. The author uses a midline suprapubic incision, stripping the peritoneum from the pelvic wall and pulling down the upper end of the lower segment of ureter. The bladder is opened along a line parallel to the course of the ureter, 3 cm. above the latter. The bladder incision is carried down almost to the bladder outlet; the lower edge of this incision is grasped with forceps, drawn outward, and a second incision is made mesial to the ureteric ridge. The mesial incision should begin and end at the ends of the first incision, so that an elliptical segment of the bladder base is removed. The vesical opening is then closed and a catheter is left in the urethra. This operation is indicated particularly in papillary carcinoma of the renal pelvis. The bladders of such patients should be examined for tumor transplants every three months for two years, and after that every six months.

The complications which may be encountered during nephrectomy for tumor are invasion of the colon, extension into the renal vein and vena cava, involvement of the duodenum with resultant tear into that viscus, injury to the vena cava, and accidental opening of the pleura.

It is difficult to estimate the end-results of nephrectomy for renal tumors. Recurrences have been reported as late as fifteen years after operation. We must be very cautious, therefore, in referring to patients as "cured." Non-papillary tumors of the renal pelvis are the most certain to be fatal. Papillary tumors of the pelvis show a better prognosis, but bladder transplants may develop.

LOUIS NEUWELT, M.D.

Rusche, C., and Bacon, S. K.: Primary Ureteral Neoplasms. *J. Urol.*, 1938, 39: 319.

Primary tumors of the ureter, whether benign or malignant, are comparatively rare lesions, if we judge by the fact that less than 100 cases have been reported in the literature. Snyder and Wood (1933) found only 1 case in the records of the Massachusetts General Hospital and Colston (1934) stated that the records of the Brady Urological Institute of the Johns Hopkins Hospital, comprising over 22,000 cases, contained only 3 instances of primary tumor of the ureter. Within recent years the condition has been reported with greater frequency than formerly, probably because there are now more definite methods of diagnosis; many of the early cases were autopsy findings; moreover, the possibility of their occurrence as independent entities in the urinary tract is now better known.

Two cases of primary ureteral tumor, one benign and the other malignant, are reported and their clinical histories given. In each of these cases the presence of the tumor was diagnosed pre-operatively by means of pyelo-ureterograms. A simplified method of obtaining pyelo-ureterograms is described, and it is suggested that this is an improvement in diagnostic procedure which will enable the only pathognomonic sign of ureteral tumor, the filling defect, to be obtained with less difficulty than formerly. The literature of primary tumors of the ureter is reviewed.

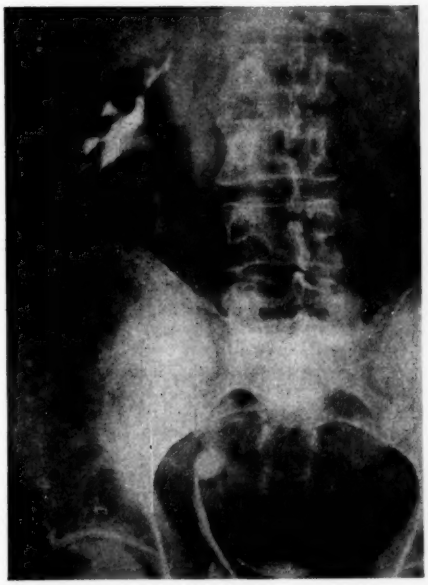


Fig. 1. First attempt at pyelo-ureterography, which was unsatisfactory. A ureteral lesion is suggested.

Fig. 2. Satisfactory right pyelo-ureterogram made three weeks later. Catheter was withdrawn by degrees. The illustration shows a hydro-ureter rapidly developing hydronephrosis (three weeks) and a filling defect in the lower third of the ureter. The diagnosis of ureteral tumor was definitely established.

For clinical purposes the distinction between benign and malignant tumors of the ureter, at least in regard to papillary tumors, is to a great extent arbitrary. The great majority of these tumors are papillomas which, as is well known, are potentially malignant, and, as a matter of fact, in course of time actually become malignant. Swift-Joly states that of 133 ureteral tumors recorded, 101 were papillary; of 61 cases of primary malignant tumors of the ureter, admitted as acceptable by Scott, 36 were papillary. In most of the reported cases of benign papillary tumors of the ureter the growth would probably have become malignant in the course of time. Squamous carcinoma and medullary carcinoma are rare.

In the literature the arbitrary division into benign and malignant tumors has generally been followed. The number of reported cases of primary tumors of both types varies according to the views of different authors regarding what constitutes an acceptable case. The criterion is to be certain that the growth in the ureter is not secondary to a primary growth elsewhere in the genito-urinary tract or a metastasis from some outside growth. Such a criterion is usually established by the pathological examination following operation or autopsy.

With the 2 cases now reported there is a total of 136 cases of primary ureteral neoplasms, 40 benign and 96 malignant, supported by adequate histological proof in the literature up to the end of 1936. A few cases not sufficiently supported by histological proof have been omitted.

The only points that seem to call for discussion are the diagnosis, the etiopathogenesis of the growths, and the treatment. There are certain signs which are presumptive evidence, such as the obtaining of clear urine from the kidney pelvis when ureteral calculi and traumatic stricture can be ruled out and there is constant or intermittent hematuria. The obtaining of fresh pure blood through the ureteral orifice, or the presence of an obstruction to the catheter in the ureter, is a very valuable sign. Smith remarks that when bleeding is from the kidney the jet is vigorous and full, but when from ureteral growths it is likely to be continuous, thick, and tarry. This, of course, refers to the bleeding of hematuria, not that from instrumental manipulation. The only positive pathognomonic sign of a ureteral tumor is the demonstration of a filling defect. However, the clinical difficulty of demonstrating such a filling defect, either by intravenous or retrograde pyelography, is very great. In comments on their own case, the authors have discussed an improvement in the diagnostic procedure. Regarding the nature and causation of ureteral growths, they classify them into epithelial and non-epithelial types, the latter arising from structures other than the ureteral mucosa. The epithelial tumors may be divided into papillomas, papillary cancer, and non-papillary cancer, the latter comprising about 42 per cent of ureteral malignant neoplasms.

The literature gives very little information as to the origin of papillary growths. Some consider that papillomas are not strictly tumors but only hyperplasias of the mucosa. The cause is variously ascribed to leukoplakia, mechanical irritation by calculi, and inflammatory irritation. One cannot but surmise that if lithiasis is a cause of tumor the latter would be observed much more frequently. The occurrence of embryonal cell rests in the ureter, as elsewhere, has been suggested as a cause of tumor, but this is more probable in the case of non-papillary tumors.

With regard to the method of operative treatment of malignant tumors there appears to be no question concerning the advisability of complete ureteronephrectomy either in one or two stages according to the patient's condition With regard to the treatment of benign tumors, especially of the papillary type, ureteronephrectomy, although an extensive and very shocking procedure, probably offers the greatest degree of safety to the patient and should be the method of choice when a tumor is definitely diagnosed. C. TRAVERS STEPITA, M.D.

GENITAL ORGANS

De Assis, S.: Clinical Observations of the Seminal Vesicles and the Seminal Ducts after Catheterization of the Ejaculatory Ducts (Klinische Beobachtungen der Samenblase und Samenwege durch den Katheterismus der Ducti ejaculatorii). *Ztschr. f. urol. Chir.*, 1937, 43: 427.

The author considers catheterization of the ducti ejaculatorii as a valuable diagnostic and therapeutic

aid in diseases of the seminal vesicles and the seminal passages. He employs his own modification of von Lichtenberg's instrument. The indications for catheterization of the ejaculatory ducts are: acute or chronic inflammations of the seminal vesicle; tumors of the seminal vesicle; chronic joint inflammations after the exclusion of other suspicious infective foci; inherited or acquired inflammatory strictures of the ejaculatory apparatus; bloody or painful ejaculations; chronic or recurrent paratesticular inflammations; sexual neuroses; and sterility. Catheterization is done for exploration, as well as for irrigation, for the introduction of medicaments, and for diagnostic and therapeutic purposes. Contraindications for catheterization are the acute inflammations of the urinary passages and of the glans penis. Stricture of the urethra calls for liberal dilatation. Patients, without exception, may be treated as ambulatory cases.

The author has collected the reports of over 100 cases. First of all, he describes the technique of catheterization with special consideration of the anatomical connections surrounding the veramontanum. For a roentgenological presentation of the seminal vesicle, an average of 2.5 c.cm. of a contrast medium, preferably thorotrast, are introduced. After removal of the catheter and emptying of the bladder, the roentgen plates are taken in the usual dorsal position. The contrast medium frequently remains in the seminal vesicle fifteen days or longer. The vas deferens often could be recognized ninety-six hours after the roentgenological procedure. The seminal vesicle gave no evidence of peristalsis. The author next describes the position and the anatomical construction of the seminal vesicle. Anomalies of this organ are seldom found. The study of its internal relief is accomplished by roentgen transillumination according to the Forssell technique as utilized in the studies of the mucous-membrane formation in the alimentary tract. The transillumination is valuable in estimating the structure of, and the changes in, the mucous membrane of the seminal vesicle; also, for examining the pressure pains, the mobility, and the adhesions of the seminal vesicle. Based upon the roentgen plates and the clinical histories, the author describes the alterations of the seminal vesicle in acute and chronic inflammation. In the treatment of inflammations of the seminal vesicle the author prefers the irrigation method. He uses a 2 per cent mercurochrome solution. The irrigations are done twice each month until the infection and the inflammation subside. If after three months the inflammatory changes remain unaltered despite the irrigations, operative removal of the seminal vesicle is undertaken.

(VON SCANZONI). MATHIAS J. SEIFERT, M.D.

SURGERY OF THE BONES, JOINTS, MUSCLES, TENDONS

CONDITIONS OF THE BONES, JOINTS, MUSCLES, TENDONS, ETC.

Lombard, P., and Tillier, H.: Spontaneous Fissures of the Skeleton (La fissuration spontanée du squelette). *Mém. l'Acad. de chir.*, Par., 1938, 64: 336.

This paper is a comprehensive case report of a patient with multiple fissures in the skeleton without history of trauma.

The patient was first seen in 1912 when he was fifteen and a half years old. His limbs were short in proportion to the trunk, the thighs were slightly flexed and outwardly rotated, and the knees in valgus deformity. Both femurs were curved anterolaterally. The spine showed lordosis and the feet were flat. The gait was awkward, the knees crossing each other. The roentgen rays showed that the inferior epiphyseal lines of the femurs had disappeared.

The boy's mother had a similar deformity of the femurs and tibia but his brothers and sisters were normal. The patient was a full-term breast-fed baby, but did not walk until he was twenty-six months old. Deformity of the legs was noticeable at that time. Genu varum was present at first, but when he was seven years old, the deformity had changed to genu valgum.

In 1912 osteotomy and correction was done on both femurs. In 1929 he reappeared as a dwarf, his deformities having recurred and increased. His hands were of the achondroplastic type. Both femurs were sharply curved outward and forward.

The roentgenogram of the right femur showed a transverse fissure extending a little more than half way through the bone from the lateral cortex inward at the apex of the curve. The edges of this fissure were clear cut, resembling a pseudarthrosis. The right tibia also showed a fissure on the concave side at about the middle of the shaft, and this was less pronounced than that located in the femur. A third fissure was found on the inferior cortex of the left femoral neck.

The fissure in the right femur seemed so serious that steps were taken to fill it in. Osteoperiosteal grafts were taken from the same femur above the lesion and layed across the defect. Vitamin D, calcium salts, and ultra-violet ray treatment were also given. Pain in the bone disappeared and the patient got back to his work. Seven years later this fissure was much diminished and the one in the right tibia was completely closed. Fissures were still present, however, in the left ulna, left tibia and fibula, and neck of the left femur. The vertebræ were bi-concave, of fish type. The pelvis resembled the bones of osteomalacia. There was no abnormality in the blood count but the phosphorus content of the blood was moderately reduced.

Nine other cases are cited from the literature. Some of the patients had painful bones. All of them were more or less benefited by anti-rachitic treatment. In 1 patient there were 43 lesions of the fissure type described, some of them causing fractures. The blood phosphorus was reduced to 2 mgm. The autopsy findings in this case were: parenchymatous degeneration in the liver, congestion in the spleen, hemorrhagic focus in the thalmic region of the brain, diffuse nephritis, congestion in the ovaries and adrenals, myocarditis, and normal parathyroid glands. WILLIAM ARTHUR CLARK, M.D.

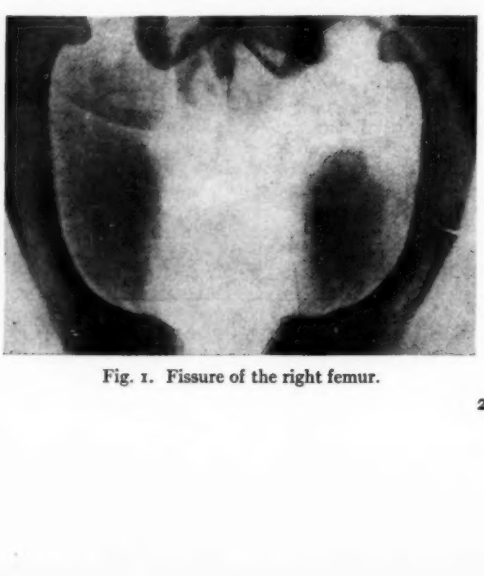


Fig. 1. Fissure of the right femur.

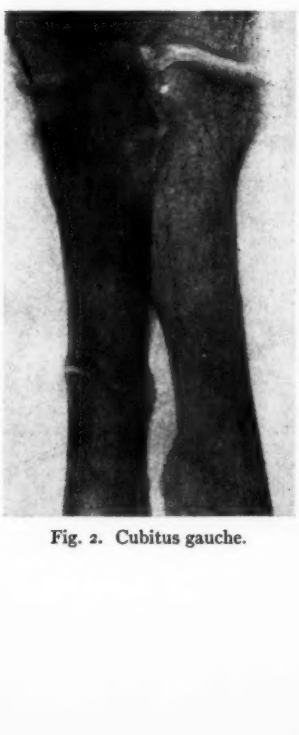


Fig. 2. Cubitus gauche.

Fig. 1.

Fig. 2.

Fig. 3.

Fig. 1. Inferior articular process of second lumbar vertebra. Early arthritic changes. The cartilaginous lining is thin in the peripheral portions. Margins of the articular facet (a) are irregular. At the cephalic pole may be seen hypertrophic synovial villus with fringed edges (b).

Fig. 2. Left. Articular surface presents a convex, quadrangular outline and is larger than that of the opposite side. The cartilaginous lining is brownish-red and is undergoing active degenerative changes (deforming phase). Granular masses of various sizes and forms are present. They are composed of chondroid substance and they produce a loose cohesion between the articulating surfaces. The capsule is markedly thickened above and externally (1) (5 mm. in thickness), whereas medially it is flaccid, paper-like and easily lacerated (2).

Fig. 3. Male, fifty-six years old. Fourth lumbar vertebra. Superior articular process. Right. Superior articular surface presents a concave quadrangular outline. The articular cartilage (1) is swollen and in some points appears to be semiliquefied.

Putti, V., and Logròscino, D.: The Anatomy of Arthritis of the Vertebral Articular Processes (Anatomia dell'artritismo vertebrale apofisario). *Chir. d. organi di movimento*, 1938, 23: 317.

The authors studied the pathological changes which arthritis produces in the intervertebral articulations, being especially interested in the organic manifestations of the primordial phases of the disease. They state that in many cases of so-called "lumbago" the clinician is often confused with reference to its cause, especially in the presence of negative roentgenograms. On careful examination the condition is not infrequently found to be due to inflammatory processes involving the intervertebral articulations.

After having discussed in detail the normal anatomy of the vertebral articulations and spinal column, Putti and Logròscino describe the commonly encountered gross pathological changes. This study includes the careful examination of 75 spinal columns derived mainly from persons belonging to the working classes.

They found that arthritis of the vertebral articular processes is encountered relatively very commonly. In general, the articular surfaces are found to be grossly unaltered up to the age of thirty. As the age advances, the lesions are found to be more progressive.

In 25 preparations the lesions were present bilaterally; in 29 cases they were more advanced on the right side, whereas in 18 cases they were found to involve the left side. The authors believe that this preponderance of lesions on the right side is probably to be attributed in right-handed persons to a greater functional activity of that side, whereas in left-handed persons the lesions are more apt to develop on the opposite side.

Putti and Logròscino also found that the lesions became increasingly more severe and more advanced toward the lower segments of the spinal column. The severest lesions were usually found in the articulations between the third and fourth, and the fourth and fifth lumbar vertebræ. Contrary to expectation, the articular surfaces between the fifth lumbar and first sacral vertebræ were often found to be normal, or to present only early arthritic lesions. The results of statistical studies made by other investigators conform rather closely with the authors' findings. In general it may be stated that arthritis of the vertebral articulations is characterized by an absolute inconstancy of localization and evolution of the lesions.

The authors also stress the etiological importance of the axial deviation of one or more vertebræ as well as deviations of the lumbosacral angle. In these conditions the vertebral processes are exposed to an increased strain and to unfavorable mechanical conditions. It was found, in fact, that arthritic processes most commonly involve originally malformed articular facets.

Of considerable importance are also the osteochondral changes, which usually involve only the margins of the articular facets. In an early stage, the articular cartilage loses its smoothness, and becomes thinner and darker in color. It finally becomes disrupted and leaves a markedly ragged margin (Fig. 1). Often the degenerative processes progress concentrically and focus toward the center.

The synovial fluid becomes more viscous, and in some cases is found to contain a granular material derived from the breakdown of the articular cartilage. Figures 2 and 3 show cases of a cartilaginous ankylosis which represents the end-stage of the arthritic process.

Putti and Logròscino also found marked alterations of the articular capsule in 57 of their cases. They believe that these changes appear only in the arthritic process and much before other lesions make their appearance. The capsule becomes markedly thickened and in 1 of the authors' cases this capsule and the ligamentum flavum combined, measured 7 mm. Calcification may occur on the external or internal surface of the capsule (extramural and endomural calcification). In some cases the authors found a solid adhesion between the capsule and the spinal nerve at the point where the latter emerges from the intervertebral foramen.

Pathological changes of the synovial villi were also encountered; they consisted of an infiltration of connective tissue containing inclusions of chondroid and osteoid tissue. In some other cases, degenerative and inflammatory processes predominated and the capsule appeared flaccid and thin, and was easily lacerated. The villi became friable and presented a leaf-like appearance.

Concerning the roentgen visualization of these arthritic lesions, the authors found that this method is highly unsatisfactory as a means of diagnosing arthritis of the vertebral column.

RICHARD E. SOMMA, M.D.

Finder, J. G.: Iliopectineal Bursitis. *Arch. Surg.*, 1938, 36: 519.

The iliopectineal bursa is a constant anatomical structure, which lies beneath the iliopsoas muscle, just lateral to the femoral vessels and inferior to Poupart's ligament. It communicates directly with the hip joint in about 15 per cent of the cases. When the bursa becomes inflamed acutely it may give rise to a clinical picture of severe pain in the groin, which is aggravated by movements of the hip, particularly extension which is relieved by rest with the hip flexed. The involved area may show a fullness warm to touch and tender to pressure. A limp hampers the gait. In more chronic cases symptoms develop insidiously. At first pain may become apparent only after the fatigue of a day's work. Pain may be referred to the knee along the irritated femoral nerve. Limp, dragging of the extremity, stumbling, and psoas weakness complete the picture. Tenderness is elicited at a point just below the inguinal ligament, half-way between the symphysis pubis and the anterior superior iliac spine. The patient assumes flexion, external rotation, and abduction of the hip for relief.

The most frequent cause is trauma. The condition occurs as the result of multiple minute occupational injuries or violent muscular activity when a sudden forceful hyperextension is accompanied by a backward thrust of the body weight. The differential diagnosis should include hernia, psoas abscess, malignancy, femoral aneurysm, and osteo-arthritis.

Treatment consists of rest and traction; definite cystic enlargement should be treated surgically by obliteration of the sac. The communication between the hip joint and bursa must be eradicated at the same time.

A report of a case and a review of the literature are presented.

Novotny, O.: The Arteries of the Mid-Foot and Their Significance in Koehler's Disease II (Die Arterien der Mittelfussknochen und ihre Beziehungen zur II. Koehlerschen Krankheit). *Arch. f. klin. Chir.*, 1937, 190: 604.

The author's investigations concerning the blood supply of the metatarsal bones showed that the so-called Koehler's disease II (aseptic necrosis of the head of the second metatarsal and less often of the third, fourth, and fifth) had a definite anatomical basis and that a disturbance of circulation, an ischemia, produced the lesion. A number of feet were injected with Teichmann's material and prepared according to Spalteholz' method in order to study the course and distribution of the arteries of the metatarsus. The method, which requires a preparation over an average of six weeks, brings out the principal differences between the blood supply of the first and that of the other four metatarsals. The nutrient artery of the first metatarsal diaphysis courses distally from the proximal end; the nutrition of the head is supplied by a greater number of arteries, which enter the head from all four sides and develop a good anastomosis between the epiphyseal network and the respective metaphyseal and diaphyseal networks. The blood supply of the four other metatarsals is quite different; the nutrient arteries arise distally and run proximally along the shafts. The heads of the latter metatarsals are so supplied that the arteries, as well as the collaterals, enter the epiphysis only from the medial and lateral approaches. The dorsal and plantar sides are devoid of vessels. Anastomoses between the epiphyseo-diaphyseal network were only slightly, if at all, demonstrable by injection. Mechanicostatic conditions lead to a circulatory disturbance, so that abnormal weight-bearing or trauma injures the collaterals of the 4 metatarsal heads, and their blood supply is embarrassed or completely obliterated.

Axhausen, Konjetzny, Payr, Aschoff, and others observed earlier that an interruption of the circulation produced a typical clinical picture; the author's work confirmed their findings objectively, since the first metatarsal head receives blood from a greater number of vessels, while the four other metatarsal heads receive their nutrition only through the two collateral sets of arteries. Contusions, strains, and narrow footgear lead to a compression of the collaterals and to circulatory damage; if these conditions are protracted ischemia and then necrosis of the head follow. The author believes that the second metatarsal is most frequently the site of

Koehler's disease since the second ray, having the longest span, is most frequently subjected to weight-bearing tension stresses.

(Riess). Jerome G. Finder, M.D.

SURGERY OF THE BONES, JOINTS, MUSCLES, TENDONS, ETC.

Risolía, A. A.: Arthrodesis of the Hip Joint in Tuberculous Arthritis (Artrodesis de la cadera en la ósteoartritis tuberculosa). *Bol. inst. de clín.-quir.*, Univ. de Buenos Aires, 1937, 13: 717.

The author studied the invalided population of a French sea-coast community. Under the guidance of Sorrel and Richard he worked in the Maritime Hospital at Berck Plage. Here tuberculosis of the hip is evidently rampant, and constitutes one of the major surgical problems. With such a mass of material available, he resolved to prepare a scientific exposition of this theme in the hope that practical and helpful conclusions might be drawn from it.

In the first part the author discusses the question, exposing the distinct surgical criteria, the chronological genesis, the principal techniques, the opportuneness and convenience. Operative indication is given special attention, and in conveniently distributed chapters the author has recorded every element which he believes useful when confronted with the result of arthrodesis of any sort whatever. He includes also a limited number of cases which he personally attended for a year, many of them with original and unpublished roentgenographs.

Keeping in mind the data of the first part, in which he attempted to sum up the present state of knowledge, he undertakes in the second a rational study of the question on the basis of principles which to his understanding have been little exploited, and which undoubtedly, in his opinion, are of great practical value. In this manner he has developed his point of view, which became concrete in a personal technique with which he experimented on cadavers.

The task was not an easy one; the problem showed itself intricate and complex. Often the arthrodesis of the hip joint showed results which were highly pleasing, at other times only moderately acceptable. There was superimposed on this contradictory result the advance of the tuberculous process, which was very different in children and adults, and there were also differences according to the anatomical clinical type. He does not deny, of course, the biological conclusions deduced from some studies which, like those of Leriche and Albee, treat of the intrinsic value of the bone graft. However, the author believes that the rôle which they accord to it as a prosthetic element of specific disposition is excessively restricted. Faced with the certain facts of progressive adduction, the antalgic attitude, the spontaneous or provoked pain, he finds the clear explanation of these phenomena in thinking of the physiomechanical behavior of the joint.

Believing that certain anatomical, histological, and embryological ideas should be kept in mind for a good practical result in arthrodesis of the hip, the author devotes considerable space to these subjects. The description of the vascularization of all the structures about the hip joint is particularly good

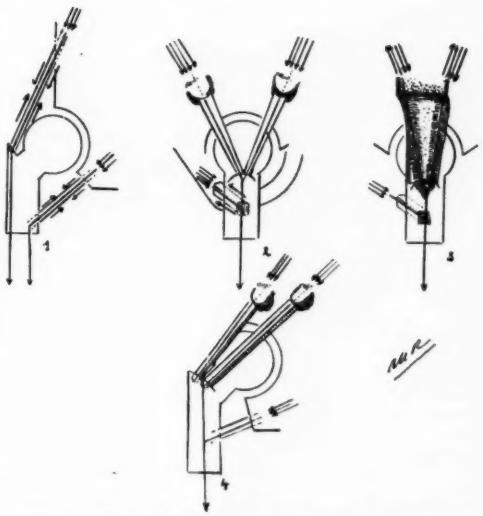


Fig. 1. Illustrating the lines of force as they act on the insertions of the grafts in the author's triple arthrodesis.

Fig. 2. Drawing of the completed para-articular triple arthrodesis.

and important in this discussion of the treatment of a blood-borne infection.

All operations for arthrodesis of the hip which have been or are popular have been classified by the author in the following manner:

1. Intra-articular arthrodesis:
   (a) Partial resection: Technique of Albee (1908), and of Delanglade (1910)
   (b) Impaction: Technique of Nové-Josserand and Tavernier (1922–1923), and of Sorrel
2. Extra-articular arthrodesis:
   (a) Juxta-articular: Technique of Haas (1923), of Hibbs (1926), of Massart and Ducroquet (1926), of Mathieu-Wilmoth, type II (1926), and of Putti (1926); also similar techniques of Albee, Wilson, and Richard
   (b) Para-articular: Procedure of Maragliano, type I and type II; technique of the double insert of Albee (1913), of Sorrel and Richard, of Rodriguea Egana (1933), of Delahaye (1932), and of Sacco (1932); transtrochanterian route of Calvé (1928); anterior route of Richard; transfemoral route of Calvé (1929); and ischiofemoral technique of Trumble
   (c) Combined: Technique of Baron (1921), and of Mathieu, type I
3. Mixed arthrodesis:
   Technique of Sorrel and Delahaye, and of Leriche
4. Arthrodesis by simple rabbeting:
   Technique of Delahaye

All of the incisions commonly and exceptionally used in the approach to the hip joint are exhaustively described.

In approaching the problem the author believes that the fundamental concept should be that the hip-joint articulation is a physical apparatus for movement and stability. An articular gearing should not be modified at caprice, and any fixation must imply permanency. He holds that much care should be taken to see that the functional substitution with regard to the proximal articulations and the position chosen as most satisfactory remove the difficulties derived from the absence of dynamics in the ankylosed area. He cites the well known fact that children as a rule benefited more rapidly and permanently, and adults, on the contrary, showed a greater number of less fortunate results. The problem was made even more perplexing by the fact that antalgic attitudes, obstinate pain, and deflections were observed in patients who were treated irreproachably.

The major portion of his treatise is then taken up by a thorough illustrated study of the arthrodynamics of the hip joint. The mechanical behavior of the pelvifemoral muscular system during standing and walking is discussed and illustrated. The transmission of forces at the level of the articulation is illustrated and set forth in algebraic equations, while other studies are made considering the thighs fixed and the pelvis movable, and the pelvis fixed and the thighs movable. Using the above conclusions, which were worked out on a normal subject, he then studied the conduct of the entire static dynamic system when associated with the development of coxalgia. Also, he discusses the activities of the static dynamic system described when there is present fibrous ankylosis (antalgia), osseous ankylosis, and the state which is brought about by all of the fusion operations listed previously.

He concludes that for very good physiological and geometrical reasons none of the operations in present use is entirely satisfactory, and he suggests one which he thinks would be an ideal solution. He believes that whatever the type of operation employed at the present, there will always be a point of articular contact in which there is no absolute repose, and pain will be or may be referred to that site in time. He reasons that from the mechanical point of view a hollow hemisphere (the acetabulum) with a slightly smaller hemispherical filling within it (the head of the femur) under conditions in which there is no direct contact between their surfaces is the ideal solution, if it could be effected with a minimum of artifices and a solidity indifferent to the pressures exercised on the section of the solid hemisphere. This mechanical recourse would be to interpose three small points of support in such a way that they would crown the vertices of a triangle which unites them. Every displacement or contact of the surfaces would then be impossible. In other words, he would apply the principle of the tripod to the arthrodesis of the hip joint and justifies this choice of procedure by comparing the results of mechanical studies on this with that of the others in common use. The operation is then described in detail and illustrated.

The author draws in part the following conclusions:

1. In spite of the most scrupulous execution, there are observed, particularly in adults, frequent unfortunate and mediocre results, such as pain and defective positions.

2. The physiomechanical conduct of the pelvis and its proper and related articulations offer sufficient analytical material for interpretation of these bad results.

3. The development of a coxalgia alters the harmony of the whole pre-existing system and creates a new one.

4. Extra-articular arthrodesis results repeatedly in an insufficient prosthetic value.

5. This insufficiency is due to the small capacity of the graft, which suffers (a) an action of flexion in the transverse sense, (b) an action of lengthening in the longitudinal sense, and (c) an action of torsion over the same. Its incapacity to oppose the adductors results from the magnitude of the section and the calcic value of its components, the greater or lesser rigidity. Its flexibility reaches defective positions, principally adduction, slowly but progressively. These defective positions, although slight, produce constant and anti-natural pressures at the level of the articulation, which induce an exacerbation of pain, or the possibility that it will appear.

6. The deficiency may be remedied on the basis of the principle of the three points of support, the tripod.

7. The principle of the tripod may be incorporated in practice.

8. The author offers a reasonable proposal for technical execution.

For those interested in the study of tuberculosis of the hip, this article is recommended as a thorough review of the subject to date, and it presents a plausible, if at this time theoretical solution.

JAMES K. STACK, M.D.

Couvelaire, R., Baumann, J., and Delinotte, P.: Technique and Indications for Complete Tibiotarsal Resection in the Treatment of Traumatic Lesions of the Ankle in the Adult (Technique et indications de la résection tibio-tarsienne totale dans le traitement des lésions traumatiques du cou-de-pied, chez l'adulte). *J. de chir.*, 1938, 51: 354.

As defined by Ollier, tibiotarsal resection means removal of the distal ends of the tibia and fibula and also the astragalus. Four cases are reported:

Case 1. Following a compound dislocation of the subastragalar joint with fracture of the astragalus and a compound dislocation at the midtarsal region, the following procedures were done: débridement, astragalectomy, removal of the fragments of the external malleolus, reduction of the midtarsal dislocation, drainage, and partial suture. Six months later, because of pain and disability, all the joint surfaces of the lower end of the tibia, upper surface of the os calcis, and posterior surface of the scaphoid were resected. Nine weeks later the patient could walk without pain, and when last seen, eight years later, function was good.

Case 2. A compound fracture of the midtarsal bones resulted in infection which prevented accurate reduction. A total tibiotarsal resection was done and the foot put in a cast. An ankylosis between the foot and leg was obtained with the foot at right angle to the leg. The arch of the foot was preserved and the patient now walks easily with a slight limp.

Case 3. A severe compound fracture at the ankle was followed by infection and general septicemia. Total tibiotarsal resection was done in spite of the infection. Although the temperature reached 40° C., the patient ultimately recovered. After several months he was walking without pain but with a slight limp.

Case 4. A woman aged twenty-four years had a high Dupuytren (Pott's) fracture with wide separation of the malleoli. Although the reduction seemed satisfactory, she had a poor functional result with extreme pain in walking. Blocking of the ankle joint and complete tibiotarsal resection were done.

In these 4 cases the operation was done, after a failure of astragalectomy in 1 case, for poor functional result due to deformity and bad callus around the ankle in 2 cases, and to avoid amputation in another case.

This operation was first done by Moreau in 1781, for a severe compound fracture at the ankle. Surgeons of the American Civil War and of the Franco-Prussian war practiced it, usually as a secondary operation. It was not much used in the World War,

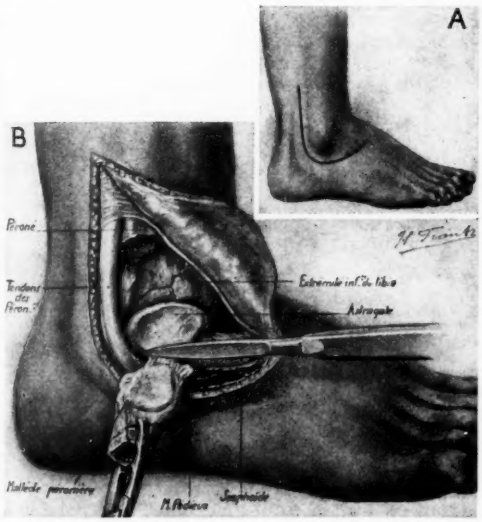


Fig. 1. External approach. A. The line of incision. B. Primary ablation of the peroneal malleolus.

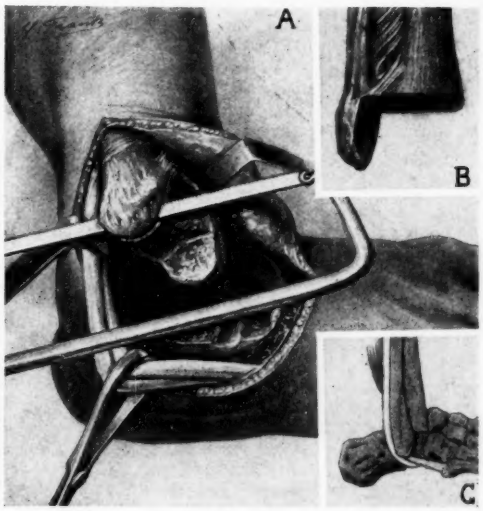


Fig. 2. After astragalectomy, cutting a window in the bone to observe the cartilage and ideal reposition.

at which time astragalectomy was preferred. The necessity of preserving the intermalleolar mortice in astragalectomy precludes the more accurate fitting of the bones that is obtained in tibiotarsal resection, in which the malleoli are sacrificed.

There are three methods of approach: (1) external incision with removal of the external malleolus; (2) external incision with conservation of the malleolus; and (3) internal incision with removal of the mesial malleolus.

The incision for the external approach goes down the posterior border of the fibula, then curves forward under the malleolus. The fibula is sawed through about 4 cm. above the tip to give free access to the astragalus, which is then removed. The articular surface of the tibia including its malleolus is cut off with a saw, the plane being slightly oblique from behind downward. The top of the os calcis is then smoothed off level. The distal end of the fibula is discarded and this bone is left a little shorter than the tibia. The obliquity of the tibia section gives the foot a slight equinus which is desirable. The final position of the foot is then slightly posterior, with the scaphoid resting against the tibia.

The external malleolus may be conserved by sawing off its mesial surface in a sagittal plane. This fresh bone surface is then fitted against the external aspect of the os calcis after the osteotomies described have been done on the tibia and the os calcis.

The internal approach is made through an incision which follows the posterior border of the tibia, cuts across the malleolus at the site of fracture, then goes downward and forward as far as the scaphoid. The flexor tendons are carefully protected while the fractured malleolus is excised. The foot is then dislocated externally, the astragalus is removed, the resections of tibia and os calcis done, and the foot put back as described above.

The indications for this procedure are: (1) certain fractures in which the bones and joint are exposed; (2) certain cases of vicious callus around the ankle; and (3) certain cases in which astragalectomy has failed. It is to be noted that indications are rare but precise.

In severe trauma in which amputation may be considered, the total tibiotarsal resection may be done as a primary and prophylactic treatment with good result. Many surgeons have reported cases in which this has been done successfully. In late cases with infection, drainage has been facilitated and recovery hastened by removal of the cartilage surfaces by resection of the ends of the bones and removal of the astragalus.

The external approach is the method of choice. The internal approach is used when there is a large wound over the internal malleolus.

When the wounds are healed and the patient begins to walk, the foot has a fairly good form. Viewed from the front, it is a little thickened, and from the side it shows a little shortening, from 3 to 4 cm. by measurement. Although there is no ankle joint, all the other joints in the foot have sufficient mobility so that the patient walks well. Flexion and extension in the midtarsal joints amount to 7 or 8 degrees. Abduction and adduction are extremely limited. The foot print is almost normal save for the shortening. The limp is minimized by taking short steps.

WILLIAM ARTHUR CLARK, M.D.

FRACTURES AND DISLOCATIONS

King, T.: Matti's Spongiosa Bone Transplant for Ununited Fractures. *Med. J. Australia*, 1938, 1: 526.

Delayed union or non-union are not uncommon occurrences in fractures of the long bones. In some cases union may be induced by the pressure stimulus resulting from weight-bearing in a walking cast or caliper. If this fails multiple subcutaneous bone drilling often succeeds. To safely carry out this procedure in the treatment of bones surrounded by important blood vessels and nerves requires an open operation. The opportunity afforded by the latter is used to better advantage by the employment of a freshening and grafting procedure. The author believes that in its main mass of bone cells an autoplastic bone graft is alive and remains so. The graft brings to the ununited bone ends some ossifying power inherent in itself. Possibly the transplant carries with it hormones or enzymes (phosphatase). The most important part of a bony transplant is the spongiosa. The latter permits of an easy influx of blood which is rich in bone-stimulating substances. The cortical bone acts mainly as a splint. Experimentally, Matti has shown that new bone will form rapidly within a periosteal tube filled with cancellous bone and that active bone regeneration occurs in the endosteal cavity from which the spongiosa was removed.

These principles are used in the treatment of cases of delayed union or non-union which do not respond to the more conservative measures. The author follows Matti's procedure. The incision is carried down to bone without individual dissection of tissue layers and the layers are retracted *en masse*. Bone exposure is minimal. In the case of the tibia longitudinal slices are cut from the bone ends with a large flat chisel which exposes the marrow cavities

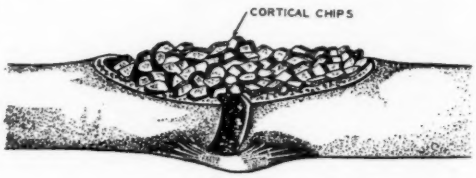


Fig. 1.

Fig. 1. Bone chips obtained by cutting up the cortical bone removed from the fractured bones are packed loosely on top of the cancellous or spongiosa transplant.

in a troughlike manner. No tourniquet is used. The exposed medullary cavity is thoroughly curetted with a sharp spoon. The pseudarthrosis is excised except for a posterior bridge which is retained to act as a hinge. Through a lateral incision a trap door or plug of bone is cut from the lateral aspect of the great trochanter of the femur and a spongiosa transplant obtained for insertion in the trough ends of the pseudarthrosis. This procedure should precede the major one. The transplant is reinforced with chips cut from the cortical bone sliced from the fractured ends.

In some cases a tibial transplant is used. This is cut so that the spongiosa is abundant and is supplemented with cancellous bone curetted from the head of the tibia.

No attempt is made to realign the fragments, the trough being fashioned to bridge the fracture gap. A few sutures hold the surrounding muscles over the transplanted bone. The skin is loosely sutured to allow for drainage. A stab drain tube is considered essential to avoid a hematoma. Plaster casts are not applied for a period of a week or ten days to avoid pressure.

The advantages of the method are listed as follows:

1. There is minimal disturbance of the blood supply.
2. Should the operation fail the patient is no worse off, a fibrous hinge having been retained.
3. There is no shortening.
4. Scraping of the medullary cavity stimulates osteogenesis.
5. Spongiosa is easy to obtain.
6. The operation has been done in the presence of infection.
7. Union is quick.

A small group of cases is analyzed.

LOUIS SCHEMAN, M.D.

Boicev, B.: Habitual Dislocation of the Shoulder (Sulla lussazione abituale della spalla). *Chir. d. organi di movimento*, 1938, 23: 354.

Boicev states that there are about 20 different methods of treating habitual dislocation of the shoulder. Each investigator of the subject claims his own method to be superior to others, but in reality only a very few of the proposed methods are of definite value.

Habitual dislocation of the shoulder is said to occur in persons between twenty and thirty years of age. It occurs rarely in infancy and childhood and after the age of forty. The condition is encountered especially in the working classes of people and it occurs preponderantly in the male. The author studied 31 cases, of which 27 were men and 4 were women.

In 27 cases (87.1 per cent) the dislocation was anterior and in 4 it was posterior. Twenty dislocations occurred on the right side, 10 occurred at the left and 1 was bilateral.

Clinically, in 7 cases the condition was accompanied by a slight muscular atrophy around the involved joint. In 1 case this muscular atrophy was very extensive. In 9 patients, abduction of the arm could be performed only incompletely. One patient was able to produce a dislocation of the shoulder at will. Three persons complained of pain on pressure over the articulation especially near the coracoid process. In 10 cases the dislocation was reduced without the aid of anesthesia. In 1 patient there was found associated with the condition a slight paresthesia involving the fingers and the area supplied by the ulnar nerve.

Habitual dislocation of the shoulder is treated by performing a capsulorrhaphy according to Putti. This is based on the common obervation that the pathological changes most often involve the joint capsule.

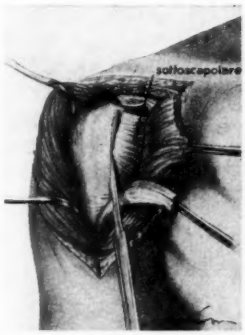


Fig. 1.

Fig. 2.

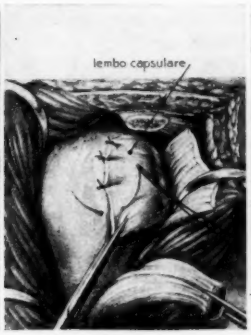


Fig. 3.

Fig. 4.

Fig. 1. Disinsertion of tendon of infrascapular muscle. Fig. 2. Showing closure of the capsular opening. The external margin of the capsular opening together with the insertion of the infrascapular muscle is sutured to the border of the glenoid fossa. Fig. 3. The residual capsular flap is used to reinforce the anterior wall of the capsule.

Fig. 4. Re-insertion of the infrascapular muscle.

On opening the articular cavity, the latter should be inspected and any pathological alterations should be removed if possible. The purpose of the operation is to make the articular cavity narrower so as to prevent dislocation. If the dislocation recurs following the operation, the technique employed by the surgeon has probably been inadequate.

Boicev operated upon 24 patients with habitual dislocation of the shoulder according to this technique. The results obtained were invariably excellent and the movements were performed by the patient with greater ease. External rotation, however, remained somewhat impaired. In 2 patients the dislocation recurred after two and four months, respectively.

The author summarizes the results obtained by stating that in 17 cases (65.3 per cent) a complete and permanent recovery was obtained. In 4 cases (15.3 per cent) there were limitations of movement; in 2 cases (7.6 per cent) the condition recurred; and in 3 cases (11.5 per cent) no follow-up history could be obtained. RICHARD E. SOMMA, M.D.

Felsenreich, F.: Fundamental Observations on the Symptomatology and Treatment of Unreduced Medial Fractures of the Femoral Neck Healed Respectively by Non-Union or False Joint (Grundsätzliche Bemerkungen zur Anzeigestellung und zur Behandlung verschleppter bzw. pseudarthrotisch oder nearthrotisch geheilter medialer Schenkelhalsbrüche). *Zentralbl. f. Chir.*, 1937, p. 2407.

Fractures of the femoral neck that are unreduced or have healed by fibrous union are seen more frequently now, according to the author, because of the wide-spread knowledge of operative results the doctor's interest is aroused, and the patients themselves consult the surgeon more often. In Austria nailing is carried out but cases of non-reduction still occur which even today are treated inappropriately, and since the surgeon believes that contra-indications exist, operation is not considered. In spite of accurate directing instruments nailing cannot always be accomplished (The author uses the Valls instrument). Frequently the roentgen reduction is insufficient and sufficient experience may be lacking. According to the opinion of the author healing is produced in medial fractures in the rarest cases by traction straps, except in a young patient. In the application of plaster the outward rotation and adduction are frequently not sufficiently overcome. Therefore, the patients are denied early appropriate treatment. The author then cites several of the so-called contra-indications. In the treatment of ununited fractures different methods are employed. Smith-Petersen, Johansson, and Boehler recommend nailing; Pauwels prefers the subtrochanteric wedge osteotomy. Both methods have their advantages. Bony healing and weight-bearing take place earlier with nailing. Moreover, it can be undertaken at any time, whereas Pauwels first recommends the osteotomy if the fractured surfaces have become polished, which often takes a long time. Boehler's instructions are as follows:

Traction should be applied at the head of the tibia for correction of upward displacement of the trochanter. If this is obtained, the question of an operation is first considered. According to Boehler's opinion displaced fractures of the femoral neck can still heal if after accurate reduction a well-fitting plaster is put on for many months. The reduction succeeds, according to the opinion of the author, only if enough of the head and neck of the femur still exist that both fragments can be tightly wedged into each other. The head is always clearly to be seen in the roentgenogram; the neck is not. Boehler recommends three views, but frequently these do not accurately show the relationships. Therefore the surgeon himself must occasionally be present at the taking of the films. The false joint can be either loose or tight at the raised trochanter. If the latter is the case, traction must precede reduction or operation. We have today the means at hand to be able to determine at the first examination which method is to be chosen. Above all the bone must be roentgen-rayed in strong inward rotation. Tight pseudarthroses with resorption of the head and neck are unfit for nailing but are suitable for wedge osteotomy. The reduction results from strong inward rotation, the patella facing 20 degrees inward; there must be strong abduction and the neck must be thrust firmly into the head. In case the fractured surface of the neck is sealed the medullary cavity must be re-opened by repeated borings from the subtrochanteric fossa. The nail is placed centrally. In front of the nail head a small pin is driven so that the bolt cannot slide out. Discretion must be used in allowing the bearing of weight in cases with marked osteoporosis. Early motion is allowed in bed. All cases are nailed in which enough head and neck exists and in which reduction is easily obtained. BARBARA B. STIMSON, M.D.

Micca, A. B., and Teramo, M.: A Clinico-Roentgenological Study of Vertical Fractures of the Patella (Contributo clinico-radiologico alle fratture verticali della rotula). *Policlin.*, Rome, 1938, 45: sez. chir. 54.

The authors give a thorough review of fracture of the patella from the roentgenological point of view, and in addition present 2 cases of their own.

They conclude that:

1. The lesion occurs at either the medial or lateral third, and almost never in the middle, of the patella.
2. There are no pathognomonic symptoms of the lesions, which makes it difficult to make a precise diagnosis.
3. A diagnosis can be made only after careful roentgenographic examination.
4. Plaster-cast immobilization should be done.

A well prepared bibliography, as well as a discussion of the etiology, pathology, diagnosis, prognosis, and treatment of the condition is given.

CARLO S. SCUDERI, M.D

Linden, O.: A Comparative Study of theTreatment of Oblique Fractures of the Shaft of the Tibia by Osteosynthesis, Osteotraction, or Only Reduction and Plaster. *Acta chirurg. Scand.*, 1938, 80: 365.

The author carried out a follow-up examination of oblique fractures of the shaft of the tibia and fibula in patients under treatment at the Maria Hospital in Stockholm, during the period from 1908 to 1932. The treatment adopted during this period was osteosynthesis with screw during the period from 1908 to 1929, skeletal traction from 1919 to 1932, and plaster alone during the whole period, with or without preliminary reduction. Rissler's method, the operative technique, with illustrations showing the instruments used, is fully described in this article. All cases subjected to osteosynthesis and extension and those treated with plaster only, from 1919 to 1932, were followed up and re-examined. The investigation was carried out with a view of finding out which therapeutic method gave the best results, either osteosynthesis with screw or skeletal traction. There has been no selection of cases in favor of one or the other method of treatment, one and the same method being chiefly employed during some definite period of time.

As the hospital was under the same supervision (Key 1911 to 1932) during nearly all this time, the author believes that this clinical material is adaptable to a comparative study. In the examination of these various groups, he tried, when possible, to come in contact with the patients personally, and himself examined all the patients that came for the follow-up examination. He was careful to observe their gait, as evidence of malposition and shortening become more evident. All cases were roentgenographed and, in addition, the nearest joint also was roentgenographed, or, if thought advisable, both joints and also the joints of the uninjured leg. In addition, in a large number of cases the non-injured leg was roentgenographed for comparison. Well kept hospitals and out-patient departments facilitated this study. Compound fractures were included in this study.

About 250 cases had follow-up examinations and studies, but for various reasons, 50 were left out of his report. Brief case reports of 47 simple fractures treated by immediate osteosynthesis, 20 simple fractures treated by simple osteosynthesis, 15 cases of compound fractures treated with oeteosynthesis, 50 cases of simple fracture treated with skeletal traction, and 19 cases of compound fractures treated with skeletal traction are described in brief case reports, and the end-results are stated. Many angles of this study are discussed in detail, such as complications in connection with the later osteosynthesis; the time of the osteosynthesis; and the treatment of compound fractures with osteosynthesis.

As a result of this thorough and detailed study of the end-results in these cases, Linden concludes that treatment by extension has not yielded as favorable results as hoped for at the outset. Moreover, he believes, the treatment is difficult and demands careful supervision and repeated roentgenographic control. Moreover, shortening and malpositions occur. He also finds it difficult for many patients to put up with extension and believes it is common to underrate the discomforts accompanied by persistent extension. He agrees that fractures which can be easily reduced and retained in good position after reduction by means of a simple plaster support should not be operated upon, but he believes that it is different with oblique fractures of the shaft of the tibia as aggravation of this condition subsequently arises in the form of shortening or angulation. It is his opinion that such fractures should be subjected to osteosynthesis with screw without delay.

His investigation of these cases has shown that the method of osteosynthesis employed at Maria Hospital is very good with regard to the period of repair and end-result. However, it is essential that operation be carried out by an experienced surgeon with good assistance and under reliable aseptic conditions.

EMIL C. ROBITSHEK, M.D.

SURGERY OF THE BLOOD AND LYMPH SYSTEMS

BLOOD VESSELS

Suzman, M. M., Freed, C. C., and Prag, J. J.: Studies on Experimental Peripheral Vascular Disease, with Special Reference to Thrombo-Angiitis Obliterans. *South African J. M. Sc.*, 1938, 3: 29.

While the ultimate histopathological picture of thrombo-angiitis obliterans is well known, the cause of the disease remains unknown. Because of the fact that the histology of the earliest stages of the disease is not definitely known, considerable diversity of opinion exists concerning the sequence of the pathological changes. Vasospasm seems to play a rather considerable part in the genesis of the disease. It has been demonstrated by means of skin-temperature reactions that in the early stages of thrombo-angiitis obliterans the arterial obstruction may be partially or entirely due to vasospasm. The maintenance of this spasm presumably leads eventually to damage of the vessel wall and subsequent thrombosis. Therefore, the authors assume that inquiry into the cause of thrombo-angiitis obliterans should be directed to an investigation of the factors which bring about continuous spasm rather than to a study of the ultimate clinical and pathological features.

Experimentally, it has been demonstrated by such investigators as Rothlin, Kaunitz, Polak, and MacGrath that the production of continuous arterial spasm following the administration or ergot or of certain of its preparations, leads to a clinical condition and a pathological picture indistinguishable from the stages of the disease observed in thrombo-angiitis obliterans; namely, spasm, cyanosis, thrombosis, and trophic lesions, such as ulceration and gangrene. Also, it has long been known that poisoning with ergot leads to intense vascular spasm followed by organic arterial obliteration with subsequent trophic changes. There are, too, numerous references in the literature to cases in which the administration of ergotamine tartrate for the relief of conditions such as pruritus, goiter, and migraine resulted in vasomotor disturbances and gangrene of the extremities.

These considerations led the authors to believe that information on the pathogenesis of thrombo-angiitis obliterans could be obtained by a study of the factors involved in the experimental production of gangrene by means of ergot. One factor which seemed particularly noteworthy at the outset of their study was that thrombo-angiitis obliterans is almost completely restricted to males. A careful search of the entire literature on the subject disclosed only 23 cases of the disease in females, most of which were mild and some of which were quite doubtful as to diagnosis. The authors assumed that this difference in sex incidence of the disease could reasonably be related to possible underlying hormonal influences. It is the investigation of this hypothesis which forms the subject matter of their paper.

In their experiments the authors used methods similar to those used by MacGrath, who in 1935 demonstrated that female albino rats receiving sufficiently large doses of theelin, ovarian follicular hormone, are protected from the trophic disturbances which otherwise regularly follow intoxication with ergotamine tartrate, while the male rats receiving theelin, although not protected, demonstrated significant delay in the onset of trophic disturbances as contrasted with the male rats not receiving ovarian follicular hormone. In addition, the authors have observed the effects of castration and of the administration of ovarian follicular hormone to castrated male rats. The results of their experiments are set forth in their paper.

Male and female albino rats were used, the ages varying from eighty to one hundred and twenty days. They were fed and housed according to the standards of the Wistar Institute. The weight of the animals varied from 90 to 250 gm. The preparation of ergot used to produce trophic changes was ergotamine tartrate. The drug was injected into the subcutaneous tissues of the back, the dose varying according to the experiment, from 25 to 50 mgm. per kgm. of body weight. The preparation of ovarian follicular hormone used in the course of the experiments was estroform, containing 1,000 international units per cubic centimeter. Observations of the trophic changes occurring in the tail were made daily until it was apparent that no further changes were taking place. The immediate consequence of the administration of ergotamine tartrate was a state of collapse lasting for from one to two hours. Within twenty-four hours there was a variable degree of hyperemia of the distal portion of the tail. Cyanosis followed the hyperemia in from three to ten days. The involved portion then became gangrenous, becoming black, hard, and dry and showing a line of demarcation. The distal gangrenous portion would often slough off completely. Occasionally ulcerative areas were noted on the affected portion of the tail.

The end-results of the experiments are of considerable interest and establish the following facts:

1. Neither a single small (1,000 I. U.) nor a single large (100,000 I. U.) dose of ovarian follicular hormone afforded complete protection against the trophic changes produced by ergotamine tartrate in both male and female rats.

2. The administration of repeated small doses (500 I. U.) of ovarian follicular hormone completely protected female rats from the trophic changes produced by ergotamine tartrate; whereas, in the males only a very slight degree of protection was afforded.

3. Preliminary castration of male rats did not affect the extent of trophic changes produced by ergotamine tartrate.

4. The administration of ovarian follicular hormone to castrated male rats afforded complete protection against the trophic changes produced by ergotamine tartrate.

Clinically, the fact looms large that thromboangiitis obliterans rarely occurs in females. In 1936, Friedlander, Silbert, and Laskey demonstrated that while a gangrenous process could be produced in male rats by daily intraperitoneal injections of denicotinized tobacco extracts, none of the female rats developed this lesion. The natural deduction from considerations such as these is that the reason the disease occurs almost exclusively in males is either because of the presence in them of some thrombogenic agent, possibly of a hormonal nature, or, on the other hand, because of the absence in males of a factor present in females, which tends to prevent the development of arterial thrombosis. Recent investigations have demonstrated a close relationship between the ovaries on the one hand, and the blood volume and the blood viscosity on the other. In Buerger's disease there is a significant lowering of the blood volume and an increase in the blood viscosity.

What biological difference protects women against this disease? Friedlander, Silbert, and Laskey in 1935, while investigating this subject thought it logical to assume that the ovaries might be responsible for this immunity. It is known that repeated attacks of phlebitis in the lower extremities occur during the years following bilateral oophorectomy and also that chemical changes occur in the blood. In the cases of 25 women who had undergone bilateral oophorectomy, these investigators found that the average blood volume showed a reduction of about 25 per cent from the normal; also, coincident with this there occurred an elevation of the cholesterol and fibrinogen of the plasma and an increase in the viscosity of the blood. The same results were obtained in experimental animals after bilateral oophorectomy. Later experiments by these same authors have shown that the administration of ovarian follicular hormone to castrated women, to men with thrombo-angiitis obliterans, to castrated female cats, and to thyroidectomized male cats, in all of whom the initial blood volume was low, caused a consistent rise of blood volume to the normal level.

In attempting to explain in what way castration was responsible for the immunity to gangrene which was demonstrated by the male cats receiving ovarian follicular hormone, the authors give the following reason:

After castration there is hyperplasia of the basophil cells of the anterior lobe of pituitary gland which is accompanied by a great increase in the concentration of the gonadotropic hormone in the blood and urine. The great increase of this substance may have enhanced the protective action of the administered estrogenic substance in some unknown manner. It is not certain whether castration or the administration of estrogenic substances produces changes in the blood volume or blood viscosity of male animals, which are similar to those found in female experimental animals.

MATHIAS J. SEIFERT, M.D.

Rosenak, S.: Congenital or Spontaneous Pathological Arteriovenous Communications and Their Surgical Importance (Ueber ange borene, bzw. spontane krankhafte arterio-venoese Verbindungen und ihre chirurgische Bedeutung). *Wien. klin. Wchnschr.*, 1937, 1: 962.

Abnormal arteriovenous communications are more frequent than is generally supposed. Recently various investigations have been made in this field, on precapillary short circuits. Histologically a normal arteriovenous anastomosis shows a distinctly arterial structure. It is of small caliber, from 0.1 to 0.3 mm., with noticeably strong musculature and with longitudinal folds of the intima. The pathological anastomosis, on the contrary, e.g., aneurysma arterio-racemosum, is surprisingly large and has thin walls. The normal is functionally capable of closing; the pathological is not. The latter, therefore, causes symptoms similar to those of traumatic arteriovenous aneurysm. How the pathological condition is produced is unknown. Repeated slight trauma and endocrine influences have been suggested.

The persistent incapability of closure of the pathological arteriovenous anastomoses causes disturbances of the peripheral and cardiac circulations. Peripherally, a dilatation of the affluent arterial trunks and their collaterals develops (Franz) which is actually produced reflexly from the periphery. The author attributes the hypertrophy, which is present usually in the growing period and always in the congenital cases, to the improved capillary circulation. However, the peripheral circulation deteriorates if the arteriovenous communications enlarge. Trophic disturbances, even necroses result; likewise cyanosis, cramps, and ischemic muscular paralyses, and varicosities of the veins. Cardiac disturbances, frequently observed in traumatic arteriovenous aneurysms, are unusual.

The diagnosis is not easy. Pathological elongation of the affected part, and occasionally perceptible bruit and elevation of the skin temperature are signs. The best method of diagnosis at present is arteriography.

In the further course of the malady venous enlargement is observed. The differentiation from congenital phlebarteriectasis may be very difficult. For differential diagnosis the Nicoladoni-Israel-Branham sign is valuable. Increase of the blood pressure with a falling pulse rate occurs on finger compression of the arterial trunk leading to the fistula. The diagnosis may be aided further by: (1) noting the comparative differences in the heat production, from 1 to 20; (2) estimation of the contained oxygen, 5:9; and (3) arteriography.

In the treatment, the injection of thrombosing agents, such as zinc chloride, ferric chloride, alcohol, and urethan; cauterization, electrocoagulation, or operative separation and removal of the arteriovenous communications are to be considered.

Spontaneous arteriovenous malformations are of frequent occurrence; 400 cases have been noted. They are found usually in the central nervous system, or in the carotid area. One hundred and six cases affecting the extremities alone are described: hand, 21; fingers, 18; forearm, 13; upper arm, 5; arm, 5; shoulder, 4; foot, 25; leg, 2; hip, 2; gluteal region, 2; not stated, 9.

Elongation of the affected members was noted in 37 cases; local trophic disturbances in 16; local excessive heat production in 30; arteriolization in 18; cardiac hypertrophy in 11; local hum and bruit in 29; and the Branham-Israel sign in 17. In 31 of these 106 non-traumatic cases the condition was congenital; in 27 it appeared at puberty.

Rosenak presents two interesting case histories of his own:

The first was that of a man forty-one years old. Ten years ago, the tips of three fingers had been struck by a hammer. The wounds healed slowly. Gradually the third, fourth, and fifth fingers began to swell and the dorsal veins of the hand became tortuous. Eight years ago a pulsating tumor appeared in the palm of the hand. There were pains in the fingers. Ligation of the ulnar artery was done which resulted in the absence of pain in the fingers for five years. During the past year, the pain recurred with ulceration of the third finger and amputation was recommended. Upon examination marked dilatation of the veins of the lower third of the forearm and of the back of the hand was noted. There was a bluish discoloration of the back of the hand and of the third, fourth, and fifth fingers with diffuse swelling. These fingers were elongated by ½ cm. Compression of the radial artery caused a decrease of the swelling and discoloration. On the third fingertip was an ulcer of the size of a pfennig. In the palm there was a pulsating swelling with a blowing murmur which disappeared on compression of the brachial artery. Arteriography of the radial artery revealed dilatation of the main vessel at the superficial palmar arch and at the origin of the third to fifth common volar digital arteries. At operation ligation of the superficial palmar arch radially to the origin of the common digital arteries was done. Immediate cessation of the pulsation, swelling, and pain occurred. The ulcer healed in four weeks. The patient is now self-supporting.

The second case was that of a man aged thirty-three years. For the past twelve years there has been an enlargement of the left forearm with marked tortuosity of the veins of the upper arm. There was heaviness and a lack of strength in the whole arm. The blood pressure was 145/85, and 220 m. on compression of the left brachial artery, measured on sound side. This increase of pressure on compression of the artery was accompanied by reduction of the pulse rate from 86 to 65 (Nicoladoni-Israel-Branham sign). The difference between the circumferences of the upper arms was 4 cm.; both of the forearms measured 2½ cm.

The affected forearm was 3 cm. longer than the right. The veins of the left arm up to the groove between the deltoid and pectoral muscles were greatly enlarged and pulsated. A loud systolic hum was heard from the back of the hand to the heart. On elevation of the arm and compression of the brachial artery the veins emptied themselves completely. If an elastic tube was then applied to the elbow region and the arterial circulation was unobstructed, the veins swelled only distally to the tube, a sign that the abnormal arteriovenous communications were in the forearm or hand. Arteriography of the brachial artery showed dilatation of the brachial, radial, and interosseous arteries, while the ulnar artery was of normal size.

At operation double ligation of the radial artery was performed, in the upper and lower thirds. Definite improvement followed and there was relief of the pain and weakness. Arteriography one-half year later showed enlargement of the interosseous artery with numerous varicose tributaries; also varicose, convoluted vessels in the thenar area which communicate chiefly with the superficial palmar arch but to some extent also with the deep arch. Resection of the interosseous artery was followed by further improvement. The resected portions of the artery showed histological degenerative changes. Three illustrations are presented.

(Franz). J. M. Salmon, M.D.

BLOOD; TRANSFUSION

Durán Jordá, F.: The Blood Transfusion Service in Barcelona; Technique and Use (El servicio de transfusión de sangre de Barcelona. Técnicas y utillaje). *Rev. de sanidad de guerra*, 1937, 1: 307.

The emergencies of war have compelled the organization and creation of an efficient and simple blood-transfusion service. Based on the conservation of citrated blood, the service uses voluntary donors in large centers of population, and has at present 4,500 donors from various walks of life. The distribution of donors by blood groups is as follows: Group I–AB, 136; Group II–A, 2,024; Group III–B, 334; Group IV–O, 1,776. The blood is tested for syphilis, and malaria is eliminated, if possible, by a careful history. After customary antiseptic and aseptic precautions the donor is bled from a vein into a special flask with filter attached. The blood is removed while the donor is fasting to avoid postprandial colibacillemias and excess of proteins, fats, and glucose which is found at the height of digestion. The Russian school (Filatov, Blina, Doepp) has demonstrated that there are more reactions from donor's blood taken after meals. About 400 c.cm. of blood are taken from each donor and mixed with a 4 per cent solution of sodium citrate (10 c.cm. per 100 c.cm. of blood). About 30 or 40 bleedings are

done at one sitting. Then the blood is tested for grouping and for bacterial contamination. Each container is labeled with the number of the donor, the blood group, and the serological reaction for syphilis. From each container a small amount of blood is taken with a capillary tube and used for a bacteriological test on agar and for blood-group determination.

After twenty-four hours, when the sterility test is read, the blood is filtered. It is insisted that the blood be filtered before each transfusion to avoid the injection of small coagula, and accumulations of fibrin, which may form small emboli.

Filtration of individual blood specimens is done with the same container in which the blood was taken from the donor. Atmospheric pressure filters the blood through a filter in the cap of the flask. Pooled blood is filtered aseptically through a special apparatus under negative pressure. The filtration occurs through a special layer of silk material. The transfusion is done by an original method, using a special two-compartment, Durán tube, under 2 atmospheres' pressure. The capacity of the tube is 400 c.cm. The sterility of the blood is determined at a glance by the color. It must be ruby red. Bacterial contamination causes gas formation and a blue venous color. By means of ordinary hypodermic needles the transfusion is readily given into any vein without dissection. Thus, the author transfused a child of five years with 300 c.cm. of blood without dissecting any veins. During the military offensive the author transfused 27 liters of blood by this means. The blood must be warmed on a water bath to 45 degrees C. for twenty minutes. The only reaction observed has been chills. This may be avoided by injecting blood at a temperature of 42 degrees. Chills are treated by injecting minims of adrenalin, and giving calcium chloride intravenously.

JACOB E. KLEIN, M.D.

Durán Jordá, F.: The Transfusion of Citrated Conserved Blood. The Problem of Dose (La transfusión de sangre citratada conservada. El problema de la dosis). *Rev. de san. de guerra*, 1937, 1: 322.

A difficult problem is to decide how much blood should be given in an individual case. The cases may be classed as acute hemorrhage, shock, chronic anemia, and those in which it is desired to stimulate the defensive powers.

The acute hemorrhage combined with physical and psychic shock must be treated by transfusion before surgery may be attempted. This usually is a massive transfusion with large amounts of blood. For example, one wounded man was given 2,400 c.cm. of blood in seven hours.

The author presents a series of brief clinical cases to emphasize some basic facts:

The first was that of a soldier with bullet wound in patella with exit in the middle third of the leg, comminuted fracture of the tibia, and marked destruction of the muscles. There was intense shock and severe acute anemia. The patient received 1,200 c.cm. of blood at one time. The surgeon then amputated the leg. The general condition was much improved. The next day the patient received another transfusion of 300 c.cm. and was evacuated.

In the second case there was a shrapnel wound of the tibia with intense hemorrhage and shock. The patient was given 900 c.cm. of blood which restored him so that his leg could be amputated. During the operation 600 c.cm. were given and later 300 c.cm. The patient was returned to bed with a pulse of 120. He died two days later in a toxic condition not related to the transfusion.

In the third case there was a bullet wound with entrance in the abdomen 3 cm. above the left iliac crest and point of exit in the right para-umbilical region. After laparotomy a severe abdominal hemorrhage occurred. Immediate transfusion of 1,200 c.cm. of blood brought about a veritable resurrection. At the end of the laparotomy 600 c.cm. of blood were transfused; and seven hours later 600 c.cm. more. The patient died forty-eight hours later of peritonitis.

A number of other similar case records are presented which show that the transfusion is a very important weapon in treating shock.

The author has also given small transfusions, from 250 to 300 c.cm., as a biological immune stimulant when it was necessary to raise immunity to infections. Thus, he treated a ten-year-old girl for streptococcus-viridans septicemia with transfusions of 300 c.cm. daily. This improved the hemogram and prolonged the child's life. JACOB E. KLEIN, M.D.

SURGICAL TECHNIQUE

ANTISEPTIC SURGERY; TREATMENT OF WOUNDS AND INFECTIONS

Bookless, A. S.: Uremia After Hemorrhage. *Guy's Hosp. Rep.*, Lond., 1938, 88: 22.

Gastric uremia following gastric hemorrhage is said to be fairly common. In the cases of 13 patients there was a marked increase in the blood urea, and in 5 it proved to be fatal. In these the urea continued high. In the cases of patients showing recovery, the urea was high at first, but a decrease was noted with clinical improvement in the patient. Though the blood urea begins to rise shortly after the occurrence of gastric hemorrhage, the clinical symptoms do not appear for a day or so, or until the period of "secondary hemorrhagic shock." This is due to fluid starvation or recurrent bleeding, or both, and the patient's condition becomes worse rapidly; the pulse tension and the output of urine are diminished. The lowest blood-urea coincident with toxic symptoms was 190 mgm. per 100 c.cm.

The author believes that uremia following gastric hemorrhage is due mainly to increased breakdown of the tissue protein. This process is rapidly increased by sudden loss of blood and is maintained or accelerated by dehydration. Sometimes absorption from the bowel, oliguria, or renal depression may augment the uremia.

The objects of treatment are to stop hemorrhage and to combat secondary collapse, as indicated by a raised blood urea. All of the patients were starved by mouth for twenty-four hours, although 10-ounce saline infusions were given by rectum at intervals of four hours. Graduated milk and water feedings were given during the next four days, and on the sixth day the first stage of a standard ulcer diet was begun. Transfusion was needed only for severe anemia, severe dehydration, and before operation.

JOHN WILTSIE EPTON, M.D.

Hageman, P. O., and Blake, F. G.: Clinical Experience with Sulfanilamide in the Treatment of Beta-Hemolytic Streptococcic Infections. *Am. J. M. Sc.*, 1938, 195: 163.

The authors report a series of 114 consecutive cases of beta-hemolytic streptococcic infection in patients who were treated with sulfanilamide. The oral administration of sulfanilamide seems to be the best method, and the authors feel that parenteral administration is indicated only when oral medication is impracticable. In the cases reported, the dose by mouth was 1 gm. per day for each 20 lb. of body weight up to 100 lb., divided into 4 doses which were given at six-hour intervals, but not more than a total of 5 or 6 gm. per day for persons weighing more than 100 lb. It is believed that 5 gm. per day represent the maximum therapeutic dose of sulfanilamide to be given orally per day.

Twenty-seven cases of erysipelas, treated by other methods in the New Haven Hospital, New Haven, Connecticut, between January 1, 1936, and January 1, 1937, were reviewed, and the results were compared with those obtained in the cases treated with sulfanilamide. The duration of the disease was thirteen and nine-tenths days in the control group, as compared with five and three-tenths days in the group treated with sulfanilamide. Spread of the disease was noted in 66 per cent of the control series, while only 11 per cent of the treated series showed more than slight marginal spread.

In a group of 7 cases of pneumonia, 3 of the patients had had purulent complications at the time treatment was begun. In these cases, the course was noticeably more protracted, with one exception. In 2 of the patients the condition subsided without surgery, while in 1, a thoracotomy was necessary even though the pleural exudate had become sterile. In this case and that of 2 others treated subsequently, the course of streptococcal empyema seemed to have been transformed into a subacute inflammation in which considerable organization, thickening of pleura, and contraction of the chest created therapeutic problems of considerable significance. The remaining cases had no purulent complications at the onset and developed none after treatment with sulfanilamide was started. Recovery in these cases was more prompt, and all of the patients recovered.

Among 5 cases of meningitis, there were 2 recoveries; these represent the only patients who have survived a beta-hemolytic streptococcic meningitis in this hospital in the past ten years.

In a group of 15 cases of mastoiditis, only 2 patients required mastoidectomy after treatment with sulfanilamide was started; all of the patients recovered.

Eleven cases of otitis media subsided, 2 without developing a discharge. In the case of one patient, relapse occurred, but the discharge promptly subsided when sulfanilamide was given. Mastoiditis or other infectious complications did not develop in any instance after treatment was started. All of the patients recovered.

Seven patients with scarlet fever were treated with sulfanilamide; 4 of them received no serum. The toxic phase of the disease seemed unaffected by the sulfanilamide. There were, however, no septic complications in this group.

Of 11 patients who were treated for lymphadenitis, only 2 required surgical therapy after treatment was started, and one of these had a mixed infection. Adenitis recurred in 2 cases, but both patients responded satisfactorily to sulfanilamide.

Sixteen patients with pharyngitis and toxic adenitis responded fairly promptly to treatment with sulfanilamide and none of them developed infectious complications.

Cyanosis was by far the most frequent complication of the administration of sulfanilamide. The authors question whether it is really a complication or a natural concomitant of the administration of this drug. Spectroscopic studies of the venous blood of 5 patients revealed evidence of methemoglobinemia, estimated to represent from 5 to 15 per cent of the total hemoglobin. In 14.96 per cent of the cases a febrile reaction occurred, with or without a rash, and coming on usually between the seventh and tenth days of the drug therapy; the term "drug fever" is suggested by the authors for this complication. Nitrogen retention developed during therapy in 3 instances; it subsided promptly in 2 of these when the drug was discontinued. In 1 instance, toxic hepatitis was noted in a patient with probable chronic cholecystitis. One patient who had been taking sulfanilamide at home was admitted to the hospital with thrombocytopenic purpura. No cases of neutropenia were noted in the present series.

The authors conclude that sulfanilamide, which is far from being non-toxic, favorably modifies the course of beta-hemolytic streptococcic infections in most instances. HAROLD C. OCHSNER, M.D.

ANESTHESIA

Desmarest, E., and Jacquot, G.: Is It Possible to Evaluate the Operative Risk and Select the Best Anesthetic by Means of New Tests? (Peut-on, à l'aide de tests nouveaux évaluer le risque opératoire et choisir l'anesthésie la plus indiquée?) *Anes. et Anal.*, 1938, 4: 60.

Desmarest and Jacquot note that the anesthesia employed is an important factor in determining the prognosis of an operation. In selecting the anesthetic it is important to know the state of the cardiovascular function. The tests described by Crampton, and by Barach and Moots have been used in the last year in surgical patients in an attempt to determine the cardiovascular condition before operation.

With Crampton's test the vascular tonus is measured by comparing the systolic pressure when the patient is recumbent with that when he has been in the erect position for two minutes. If the pressure falls, this is an unfavorable sign; if it remains stationary or rises, it is a favorable sign. An acceleration of the pulse rate after two minutes in the erect position is also an unfavorable sign; the greater the acceleration is, the worse the prognosis. If there is little or no acceleration of the pulse, the patient is a good surgical risk. Crampton has published a table the abscissas of which show the variations in the systolic pressure; the table ordinates the variations in the pulse rate. Crampton's index can be determined for each case. In this table 100 represents theoretical perfection, 75 is excellent, 65 moderately good. The lower the index is, the less favorable the prognosis for operation. The index may be a *minus* value; the authors had one case with a −75 index in a cachectic patient with cancer of the stomach. An illustrative case shows the use of this table:

In a young man twenty-five years of age, to be operated on for inguinal hernia, the systolic pressure was 12 cm. (Hg) in the recumbent position and after two minutes in the erect position, 13 cm., which showed an increase of 1 cm. mercury. The pulse rate in the recumbent position was 72; after two minutes in the erect position it was 86, an increase of 24. In the table, the column for 1 cm. increase in pressure followed downward to the horizontal line corresponding to an increase of 24 in the pulse rate gave an index of 75, showing the patient to be in excellent condition for operation. On the other hand, in a patient of sixty-seven with cancer of the stomach, the systolic pressure diminished 4 cm. (Hg) and the pulse rate increased 24, which gave a Crampton index of −50 and indicated a very unfavorable condition.

In 113 cases in which the Crampton test was made prior to operation, the index was 75 or more in 65 cases; between 75 and 65 in 13 cases; and below 65 in 35 cases. The patients with an index of 65 or more were all in good condition, and the selection of the anesthetic presented no difficulties. In these cases nitrogen protoxide or cyclopropane was employed, with rectanol as a basic anesthetic if complete muscular relaxation was desired. In cases with an index below +65, the same anesthetics were employed in the more favorable cases, but local anesthesia in the less favorable cases.

The chief objection to Crampton's test is that with some patients it is impossible to keep them in the erect position for two or three minutes. For them the index of Barach may be employed, which is determined by multiplying the figures for the systolic pressure and the diastolic pressure taken in the recumbent position by the pulse rate and adding the two products; to be of favorable prognosis the index should be between 1,300 and 2,000. Moots' "index of operability" is the ratio of the differential pressure between the systolic and diastolic pressure to the diastolic pressure; this should be between 25 and 75 per cent, if the patient is operable; values below or above are unfavorable. In cases of hyperthyroidism, Bartlett's breathing test may be employed.

If these tests show that the cardiovascular function is deficient and there is no emergency, operation should be deferred, and the patient given suitable preparatory treatment. If the condition does not respond to this treatment, it is better to avoid operation entirely, unless it is absolutely necessary; if operation is necessary, the anesthetic that is the least toxic should be employed. ALICE M. MEYERS.

Weese, H.: The Problem of Narcosis with Fluid Anesthetics (Considérations sur le problème de la narcose par les anesthésiques liquides). *Anes. et Anal.*, 1938, 4: 1.

Weese notes that until recently general anesthesia was induced only by inhalation, but at present the use of fluid anesthetics given in solution by intravenous injection or by rectum is receiving considerable attention.

With ether, as typical of inhalation anesthesia, high concentrations must be used to induce anesthesia rapidly; after satisfactory anesthesia has been established, lower concentrations may be employed. Inhalation anesthesia is controllable, because inhalation can be stopped at any point, and the patient then exhales the excess ether. The margin between the fatal dose of ether and the dose necessary to obtain complete narcosis is slight as determined by the concentration of ether in the venous blood; the fatal dose is from 1.4 to 1.6 times that of the narcotic dose.

The rapidity of absorption of avertin given by rectum depends upon whether it is absorbed entirely through the rectal mucosa or partly through the mucosa of the large intestine. The rapidity of absorption of avertin and the initial concentration of the drug in the blood vary in each case. The duration of anesthesia with avertin depends upon the balance maintained between its absorption, its diffusion in the tissues, and its elimination. The liver is the organ chiefly responsible for the destruction and excretion of avertin, and hence it is excreted gradually. Because avertin is absorbed slowly, and its absorption cannot be stopped after it is once begun, its absorption cannot be controlled, as with inhalation anesthesia. The margin between the fatal and the narcotic dose of avertin has been found to be about the same as that of ether. Motor excitation and vomiting are rarely observed with avertin anesthesia.

With liquid anesthetics administered by intravenous injection, the effect depends upon the rapidity of the injection. The two anesthetics most frequently employed for intravenous injection, evipan and pernocton, which are both barbiturates, are also excreted by the liver, and are gradually excreted. These barbiturates when injected intravenously have an immediate effect, and the dosage employed and the rapidity of the injection must be determined by the reaction of the patient. From the author's determination of the concentration of evipan in the tissues of experimental animals, he concludes that evipan, and probably also pernocton, is rapidly diffused in the tissues. Pernocton is less rapidly broken down by the liver and hence less rapidly excreted than evipan, and anesthesia is therefore more prolonged with pernocton. The margin between the fatal and the narcotic dose of evipan is considerably greater than that of ether and avertin; but with pernocton it is about the same as with avertin, while with both the latter drugs the anesthesia may be prolonged. Evipan and pernocton in toxic doses act primarily upon the respiratory center, not on the circulation; artificial respiration may be used to overcome this toxic effect, as with inhalation anesthesia.

Avertin and pernocton may be used as basic anesthetics supplemented by inhalation anesthesia. However, evipan with its higher margin of safety may be used without supplementary anesthesia when the operation is of short duration. For longer operations inhalation anesthesia must be employed with evipan. To prolong the anesthetic effect of evipan, repeated small injections may be given. A review of statistics from the world literature shows that the mortality from evipan anesthesia is very low, and is being still further reduced.

ALICE M. MEYERS.

PHYSICOCHEMICAL METHODS IN SURGERY

ROENTGENOLOGY

Orr, C. R., Popoff, G. D., Rosedale, R. S., and Stephenson, B. R.: A Study of the Effect of Thorium-Dioxide Sol Injected in Rabbits. *Radiology*, 1938, 30: 370.

The large number of recent contributions to the literature suggesting the use of radio-active substances as a diagnostic therapeutic measure prompted the authors to investigate the latent effects of thorium-dioxide sol upon experimental animals. As an introduction to their study, they discuss at some length the radio-activity of thorium-dioxide sol as revealed by reports from various sources. They also review the literature of its effects as reported by numerous authors, and cite 36 articles listed in the bibliography favoring its use, with very little mention of any possible danger. The work of others who have arrived at contrary conclusions is also given due consideration.

Two methods of approach were used in this study:

1. Experimental animals were injected with the sol and detailed microscopic examinations made of the reticulo-endothelial structure after periods of from twenty-four hours to three hundred and eighty-five days.

2. Roentgen-ray films were exposed to prepared ampules of the sol, to dried specimens of the liver and spleen, and to histological sections in an effort to demonstrate radio-activity. The purpose of the investigation was to determine: (1) the site of storage, (2) the delayed effect on body tissue, (3) the degree of radio-activity, (4) the rate of elimination, and (5) the route of elimination.

Detailed data of the experimental procedures are given together with the radiological and pathological findings. Results of the study are summarized:

1. Injected thorium is engulfed by the reticulo-endothelial system, i.e., the reticulum cells of the splenic pulp, lymphatic tissue, and bone marrow; the endothelial cells of the liver capillaries (Kupffer cells), lymph sinuses, splenic sinuses, bone marrow, and suprarenal capillaries; and the phagocytic cells in connective tissue.

2. There has been no evidence of elimination of this substance from the body during a four-year period of observation. This apparently results in a permanent blockage of the reticulo-endothelial system, and may thus impair its immunological properties.

3. Thorium-dioxide sol has been demonstrated, by means of shadowgrams, to be definitely radio-active both in prepared ampules and when engulfed in body tissues. Even minute amounts of injected tissue have been shown to be radio-active by means of histoshadowgrams and by the spinthariscope. The use of filters has shown that both alpha and gamma radiation is present.

4. The following histological changes have invariably been found:

a. The reticulo-endothelial system phagocytoses the thorium dioxide.

b. The liver shows pathological changes varying from simple cloudy swelling to profound necrosis and depending upon the dose. These changes are followed by the proliferation of fibrous tissue, which presents a picture similar to mild nodular hyperplastic cirrhosis.

c. The spleen shows damage varying from degeneration of the lymph follicles to marked necrosis, even of the vessels and interstitium.

d. The bone marrow contains large clusters of thorium and shows hematopoietic depression.

e. The lung histocytes contain thorium with no definite tissue damage.

f. The adrenals contain thorium in the reticulo-endothelial cells. There is questionable degeneration of the cortical cells in the zona glomerulosa.

In conclusion the authors state their belief that thorium-dioxide sol should not be injected into human beings because:

1. It is not eliminated from the body.

2. It apparently blockades the reticulo-endothelial system and may thus adversely affect some of the body's immunity mechanism.

3. It may, as in their experimental animals, profoundly damage the parenchyma of the liver and spleen, with early and late degenerative changes.

4. It is a radio-active substance, and undoubtedly has dangerous cumulative radio-active effects.

ADOLPH HARTUNG, M.D.

Dresser, R., and Spencer, J.: Physical and Clinical Observations on the Use of Million-Volt X-Rays. *New England J. M.*, 1938, 218: 415.

A new type of x-ray generator, operated routinely at a constant potential of 1,200,000 volts, has been used by the authors for six months in the treatment of malignant conditions and in carrying on certain physical investigations, the results of which are reported in this article. The average wave length produced by it approaches that of the rays of radium. The quantity of radiation has been estimated to be equivalent to that which would be obtained from 2,000 gm. of radium element. The apparatus has been found to be as reliable mechanically as any of the low-voltage commercial x-ray units.

The authors have found that the skin will tolerate twice as much x-ray irradiation delivered at 1,000,000 volts, as it will at 200,000 volts. Moreover, if equal doses of 200,000-volt and 1,000,000-volt x-rays are applied to the skin, about 20 per cent more of the latter will reach the center of the body. The combination of these two factors, that is, the greater skin tolerance and the greater penetrating power, allows the administration of more nearly adequate

amounts of radiation to deep-seated tumors without appreciable damage to the superficial tissues. Also surprisingly little roentgen sickness has been noted following million-volt therapy.

It is the authors' impression that satisfactory results are to be expected only in those tumors which have shown themselves to be in some degree sensitive to low-voltage radiation. However, a case of laryngeal carcinoma is cited in which treatment by the supervoltage method produced strikingly favorable results after treatment with radium implantation, and after heavy doses of 200,000-volt roentgen rays had failed to check the progress of the disease.

A brief analysis of the cases of 101 patients who received 824 treatments during the first six months the machine was in operation, is given. The cases are tabulated as to lesions treated. Patients treated for breast tumor reacted much the same as those treated with lower voltages, except that there was less skin reaction and roentgen sickness. Laryngeal lesions also developed much less superficial reaction, which the authors believed to be a decided advantage in that radiation could be repeated after several months, if indicated. Bladder tumors yielded much more favorable immediate results, partial or total regression with symptomatic relief occurring in almost every instance. Much palliation was afforded in all patients with carcinoma of the prostate, but in no instance was there complete disappearance of the neoplasm. One patient with carcinoma of the esophagus became symptom-free, gained weight, and presented a normal esophagus roentgenologically.

Observations thus far lead the authors to believe that in the treatment of deep-seated neoplasms the immediate results of 1,000,000-volt x-ray therapy, even though they may prove to be only palliative, are superior to those obtained with lower voltages.

ADOLPH HARTUNG, M.D.

MISCELLANEOUS

Vallebona, A., and Benvenuto, G.: The Effect of Short-Wave Therapy upon Cutaneous Reactions Produced by Ultraviolet and Radium Rays (L'influenza della marconiterapia sulle reazioni cutanee da raggi ultravioletti e da raggi del radium). *Radiol. med.*, 1938, 25: 227.

Vallebona and Benvenuto review briefly the literature concerning the biological effects obtained by the combined actions of certain physiotherapeutic agents, with special reference to the action of short-wave therapy upon certain cutaneous reactions produced by ultraviolet and radium rays. In a further study, the author substituted infra-red rays in place of short-wave therapy. In general, the effects obtained in each case were studied with reference to the time at which short-wave therapy was instituted and the time that actinotherapy was instituted.

This study embraces a long series of observations from which Vallebona derives the following conclusions:

In combining short-wave therapy with ultraviolet irradiation, certain biological reactions are obtained, the intensity of which depends primarily upon the relative order of administration of the two named physiotherapeutic agents.

The most intense reactions are obtained when ultraviolet irradiation is followed immediately by exposure to short waves. The intensity of the reactions gradually decreases (in the order given) if short-wave therapy is followed immediately by exposure to ultraviolet rays, and if exposure to ultraviolet rays is followed in two hours by short-wave therapy. The least intense reactions are obtained when ultraviolet rays and short-wave therapy are given simultaneously. All the aforementioned biological reactions, however, are more intense than those obtained with ultraviolet irradiation alone.

In studying the combined effects of ultraviolet and infra-red rays Vallebona and Benvenuto found that variable results are obtained. No definite conclusions may be drawn from their series of observations and, in agreement with other investigators, the authors state that it is yet highly problematical whether these two physiotherapeutic agents possess a mutually antagonizing or a synergistic action.

In considering the combined effects of radium rays and short waves, the authors found that (a) radium irradiation followed immediately by exposure to short waves yields more intense reactions than exposure to short waves followed immediately by exposure to radium rays; (b) the application of radium rays followed in successive days by exposure to short waves yields more intense reactions than the simultaneous application of both agents; and (c) the simultaneous application of radium rays and short waves yields more intense reactions than radium rays alone.

From this study the authors conclude that short waves have a distinctly sensitizing action upon cutaneous reactions produced by actinic irradiation. This biological action should be thoroughly investigated and its potential value in the treatment of neoplasms should be considered.

RICHARD E. SOMMA, M.D.

MISCELLANEOUS

CLINICAL ENTITIES—GENERAL PHYSIOLOGICAL CONDITIONS

MacCollum, D. W.: Wringer Arm. *New England J. M.*, 1938, 218: 549.

The author reports a series of 26 cases of wringer arm injury. This type of injury is seen in all age groups, but it occurs most frequently in early childhood. The child's finger is caught in the rollers of the electric wringer and the entire arm is pulled along with such force that the child is unable to extricate himself. Usually, the rollers continue to churn away until the motor is stopped or the safety release is applied.

Twenty-two of the 26 patients in this series were children between the ages of two and five years. The extent of their injuries was variable; no nerve lesions were seen and only 2 minor fractures occurred. The primary trauma was to the skin, the subcutaneous tissues, and the muscles. In each instance there were marked ecchymosis, edema, and abrasions of the skin. Three patients received lacerations which required suturing, and in 7 patients the trauma was sufficiently severe to cause necrosis of the skin and underlying tissues.

When such accidents occur, the arm swells immediately and the intact skin becomes blotchy. The extent of injury to the soft parts cannot be properly evaluated at the first examination and, because of the swelling, examination for fracture is difficult. For this reason a roentgenogram should be taken in every case of wringer arm injury.

In the treatment of a fresh injury, the first procedure should be immobilization by means of a sling or sand bag. Edema must be reduced, and the author advises the application of ice packs for twenty-four hours and alternate hot and cold packs the second day. A rigid aseptic technique must be carried out in the treatment of abrasions, to prevent the development of sepsis in the devitalized tissue.

In cases of patients seen several days after the occurrence of the injury, either the entire arm is found to be swollen, red, and painful, with evidence of cellulitis, or an area of necrosis has developed. The cellulitis is treated by the continuous application of hot packs, plus general care for improvement of the patient's condition. If necrosis has developed, further treatment is necessary. Necrosis is slow to develop and, as noted above, occurred in 7 of the author's patients, only 1 of whom was seen shortly after the accident.

The author believes that if the treatment outlined for fresh injuries is carried out, a minimal amount of sloughing will occur. If the injured tissue does not respond to efforts to revive it, the gangrenous area will soon become demarcated. Because it is impossible to judge the depth of the necrosis, caution against the removal of this slough is advised, and continuous soakings to accomplish its removal are suggested. Following removal of the dead tissue, the site is usually found to be cratered and covered with chronically infected granulations. The covering of these raw areas with epithelium in the form of thick razor grafts is advised; and if contractions develop later, a plastic procedure can then be accomplished in an aseptic field, at a more advantageous time for good healing. It must be remembered that these are crushing injuries and that extensive injury to the tissue surrounding the granulating area has occurred, which must be covered by grafts. It is necessary therefore to hasten the formation of healthy granulation tissue. The author's method of treatment consists of daily hypertonic baths, and the application of wide-mesh paraffin gauze covered by sponges which have been soaked in eusol, and held firmly by elastic bandages. When the raw area has become cherry pink and the condition of the patient is sufficiently improved to withstand operation, the grafts may be applied. The author describes briefly a technique for razor grafting.

HARVEY S. ALLEN, M.D.

Burrows, H. J.: The Developmental Abbreviation of Terminal Phalanges. *Brit. J. Radiol.*, 1938, 11: 165.

The author describes 3 cases of developmental abbreviation of the terminal phalanx of the thumb. This is a rare condition and only a few cases have been previously reported. The literature is summarized and the condition is discussed.

Most of the reported cases and 2 of the author's show involvement of the terminal phalanx of the thumb alone. A few show similar changes of the terminal phalanges of the other digits. There is no associated disability. The pathology of this condition is essentially shortening of the shaft of the terminal phalanx. The nails are short and perhaps broadened. The soft tissue of the terminal segment

Fig. 1. Hands of the patient.

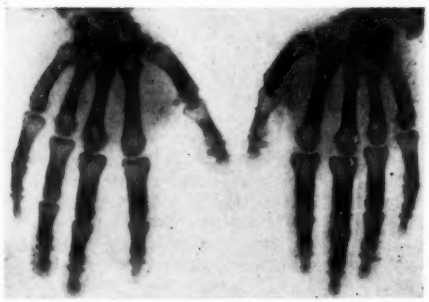


Fig. 2. Skiagram of the hands.

of the thumb is thickened. Most cases show a familial tendency, and their genealogy is shown.

The incidence of this condition is believed by some to be about 1½ per cent of all hands examined. No racial tendency is apparent and the two sexes are about equally affected. The author believes the ratio of bilateral to unilateral appearance is about 2 to 1. The age of onset cannot be determined. This condition, in the majority of instances, is unassociated with other deformities. A few cases from the literature have shown a similar condition of the toes, shortened middle phalanges, or short metacarpal bones.

The author discusses the cause of this condition, which seems to be associated with a tendency to premature fusion of the epiphyses of the affected phalanges. He concludes that there must be some common factor which is responsible for both the initial shortening and the premature fusion of the epiphyses.

HARVEY S. ALLEN, M.D.

Tochtrop, G.: Latent Gas-Bacillus Infection (Beitrag zur ruhenden Gasoedeminfektion). Muenster: Dissertation, 1937.

The incubation period of gas-bacillus infection can be limited, according to Hancken, to three weeks. After that time, one should speak of latent infection. Gas-bacillus infection is not necessarily associated with gas gangrene. Marwedel found gas bacilli in 72.7 per cent of 72 war wounds, and none of the patients developed gas gangrene. The bacilli pathogenic for man, according to Zeissler, are listed in the following order: (1) Welch-Fraenkel, (2) Novy's bacillus of malignant edema, (3) Vibrion septique, and (4) bacillus histolyticus, which is only pathogenic in symbiosis with the others, but not by itself.

The clinical picture is described. Emphasis is placed on the initial pain, which has its location in the musculature. The division into epifascial and subfascial forms according to Payr is discarded, as is also Theiss' division into blue and brown forms.

Twenty-five cases of latent infection are collected from the literature. The duration ranged from six weeks to eighteen years. The condition always became manifest after operation. Eleven or 44 per cent of the patients died. Those treated with serum showed a mortality of 14.3 per cent; those that did not receive serum a mortality of 58 per cent. In 2 cases a primary infection occurred immediately after the gunshot wound. Gas bacilli were found bacteriologically 11 times. In the other cases cultures were negative or were not made. Since latent infection is to be feared even after many years, prophylactic gas-bacillus and tetanus serum should always be given before operations following gunshot injuries are performed.

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